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Speed Up the Building of Ships

WHILE the general public seems oblivious of the difficulties which must be overcome in providing an emergency fleet to offset the U-boat menace, shipbuilders have no such illusions. To them an emergency fleet means the progressive increase of output of shipyards and engine works. It means the expansion of a shipbuilding force of some 60,000 men into a shipbuilding force of from 150,000 to 200,000 men. It means the rapid expansion of existing shipbuilding facilities and the building of new shipyards. It means the prompt delivery of vast quantities of the various materials that go into the construction of ships. It means increased efficiency of production and, above all, it means the elimination of delays.

Two of the requisites for building an emergency fleet have been provided: Congress has appropriated the necessary funds and given the authority for carrying out the work, and steel makers and lumber interests have pledged the necessary materials. The United States Shipping Board Emergency Fleet Corporation, which is entrusted with the task of building this fleet, has spent the first three months of its existence principally with making plans; the actual construction of ships has scarcely begun. Contracts for something over 800,000 tons of vessels, including 38 steel ships, 34 wooden ships, 32 composite ships and 72 wooden hulls, have been placed. Most of the wooden ships will be of about 3,500 tons, while the steel ships range from 5,000 to 10,000 tons each; but the first of these ships will not be completed until February, 1918, and many of them will not be delivered until the winter of 1918-1919. At the rate at which the U-boat toll has been maintained since February 17 it is very apparent that not a moment's time can be wasted in building American ships.

Marine Oil Engines Wanted for Naval Reserve Officers' School of Instruction at Columbia University

THE engineering school for advanced naval engineering instruction at Columbia University, New York, is now being utilized for the training of officers of the Naval Coast Defense Reserve of the New York district. These officers are being given an intensive course to fit them at the earliest possible moment for the responsibilities involved in operating motor boats of the Coast Defense fleet, but owing to the lack in the laboratories of the university of large-size marine oil engines such as are to be installed on the Coast Defense patrol boats, Professor Charles E. Lucke, in charge of the instruction, has issued an appeal urging owners of engines of more than 100 horsepower to loan them to the school for the emergency period. Such engines may be shipped without any formality direct to Professor Lucke at Columbia University, 118th street and Broadway, New York.

Reinforced Concrete Shipbuilding—A Field for Pioneers

THE pressing need for ships and the existing congestion in American shipyards have led to a consideration of the possibility of utilizing other materials than wood and steel for shipbuilding. The most promising alternative is undoubtedly reinforced concrete, and already several prominent engineers have turned their attention to its application to the construction of ships. Various phases of the question are discussed in two articles published elsewhere in this issue.

Reinforced concrete ships are not a novelty. In San Francisco a firm of engineers is designing a ship with a length of 330 feet, a beam of 44 feet and a depth of 31 feet; with a capacity of 4,500 tons, to be built of reinforced concrete. As far back as 1898 a concrete schooner was employed for some years in the North Atlantic coasting trade. The London *Times* recently mentioned a small boat of reinforced concrete built by a Frenchman in 1849 which is still in service after a period of sixty-eight years. Concrete lighters have been used for the past six years on Chesapeake Bay, supplying coal and water to dredges carrying loads of sand and gravel, etc. A concrete barge has been in service on the Welland Canal since 1910 and has seen very hard usage. It has a length of 80 feet, a beam of 24 feet and a depth of 7 feet. The walls of the barge, which were constructed between forms, are 2½ inches thick, reinforced with steel rods. The barge has been used for carrying loads of stone, etc., with conspicuous success. Since 1910 reinforced concrete barges have been built for use on various sections of the Panama Canal, and their experience has enabled the engineers to develop a very efficient type of vessel. Recently concrete pontoons were constructed for service as landing stages for boats up to 65 feet in length. These pontoons have a length of 120 feet, a beam of 28 feet and a depth of 8 feet. They are very thoroughly reinforced.

Vessels which are much more like ships than barges have been built of reinforced concrete in Norway. A report from the American Consul-General at Christiania describes a plant at Moss, Norway, where vessels of 5,000 tons displacement are being constructed. At this place a concrete lighter having a displacement of 3,000 tons, which is being built for a mining company at Sydvaranger for the oversea export of iron ore and the import of coal, will be completed before the end of the current year. Two other lighters are now on the stocks and a large slip for a 4,000-ton craft is nearly completed. More than 200 men are now working in the new yards and five lighters have been contracted for in addition to the one completed and the two on the slips.

In view of such examples, proving the usefulness of concrete vessels of this character, the possibilities of constructing seagoing barges or other smaller craft suitable

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for inland waterway traffic should be carefully investigated in the United States, for the substitution of such vessels for existing tonnage would in a short time release for other purposes many ships now used in domestic service. The presence of the necessary materials for building concrete vessels at so many convenient locations, and the ease and rapidity with which they can be built by unskilled labor, would seemingly make it possible to provide a large tonnage of such craft in a relatively short time.

Progress in the development of seagoing concrete steamships must necessarily be slow at first, as real information is lacking as to how such vessels will stand up under shocks. Seafaring men who have handled vessels in North Atlantic winter storms or in West Indian hurricanes realize that such information cannot be gained from laboratory experiments. The behavior of actual concrete ships under power in a seaway must be studied.

Transportation on Inland Waterways Must Be Developed

Owing to the fact that to-day the railroads of the United States are carrying more freight than ever before in the history of the country, and that the total railway transportation facilities now available will be insufficient to handle the tremendous volume of freight which must be transported for war purposes in the immediate future, the Department of Commerce has issued an appeal for the immediate development of transportation on our inland waterways. No one who knows the facts will question that the railways of the country are overwhelmed by the present traffic. There is said to be a shortage of 150,000 cars. Although radical measures are being taken by the railroads in the effort to meet the situation by curtailing passenger traffic, installing new locomotives and cars as rapidly as they can be built, and regulating traffic so as to secure the most effective use of the equipment which is available, nevertheless, even with the universal application of such measures, the facilities of the railroads will soon be entirely inefficient for the task laid upon them. Under these circumstances it is necessary that every possible use be made both for local and through freight of all interior waterways, canals, rivers and lakes, and this must be done not only as generally, but as quickly as possible, if transportation facilities are to escape serious congestion and if our part in the war is not to be seriously hampered.

For years many of the great waterways of the land have been practically unused. The railroads have been antagonistic to the development of inland waterway transportation, and without co-operation with the railroads no development of the waterways has been possible. With the new order of affairs introduced by the war, however, there can be no question of the mutual advantage to the railroads and to the communities bordering on inland waterways which can be secured by utilizing the facilities which the inland waterways offer for transportation.

It is to the interest of the cities and towns on waterways to take immediate steps to encourage water transit and to extemporize, if need be, means for bringing it quickly into service. Every river, lake and canal should be used. Every enterprise, large or small, looking toward their practical use should have the encouragement not only of the cities and towns which they serve, but also of the railroads feeding such waterways. The problem is not only an economic one, but it is a patriotic one. It means that everyone who has available floating equipment which can be used for cargo transportation on inland waterways, whether in the form of barges, motor boats or river or lake steamers, should immediately take steps to make this equipment available for transportation purposes. Numerous boat building yards exist, especially on the large western rivers, which for years have been operated at small capacity, or have been practically idle. These yards should be built up and extended. New yards should be built. Engine and boiler manufacturers should prepare to co-operate with the boat builders and make it possible to create in the shortest possible time tonnage suitable for transporting both bulk and miscellaneous freight on the adjacent available inland waterways.

The movement to utilize the inland waterways has the approval of the War Department, the Commerce Department and the Shipping Board, and a committee under the advisory commission of the Council of National Defense has been formed to advise in promoting the immediate use of all inland waterways. This committee consists of the following: George E. Bartol, president of the Philadelphia Bourse; Brigadier-General William M. Black, Chief of Engineers, United States Army, Washington; Captain J. F. Ellison, Cincinnati, Ohio, former secretary of the National Rivers and Harbors Congress and late general manager of the Amazon Navigation Company; Joy Morton, Chicago, Ill.; James E. Smith, St. Louis, Mo., president of the Mississippi Valley Waterways Association; Walter S. Dickie, Kansas City, Mo., president of the Kansas City-Missouri River Navigation Company, and M. J. Sanders, president of the New Orleans Board of Trade and representative for many years of the Leyland Line of steamers.

Sea-Going Yachts Needed for Immediate War Duty

In connection with the quiet campaign of preparedness which is being carried on under the orders of Franklin D. Roosevelt, Assistant Secretary of the Navy, and about which there has been no previous public announcement, an active effort has been under way during the last month to procure sea-going yachts for immediate war duty. Vessels of this kind must be not under 110 feet in length, with sea-going ability and of large cruising radius. The Government will employ a large number of such vessels as auxiliaries to the other fighting units of the navy, and the patriotic spirit of many owners who have already come forward to turn over their vessels for this valuable service is worthy of commendation. Not only from ports on the Atlantic Coast but from various points on the Great Lakes a fleet is being rapidly mobilized, and a number of fine yachts, now in process of alteration, will very shortly be added to the fleet of the navy.

About a month ago the Assistant Secretary of the Navy organized a Special Board for Patrol Vessels, whose duty is to secure suitable boats with all possible dispatch. One of the first moves of this Board was to have the International Mercantile Marine Company, 9 Broadway, New York City, designated as the official agents of the Special Board. This brings to the assistance of the navy in these times of stress the services of the International Mercantile Marine Company's large staff of shipping experts, all of whom are giving their services without remuneration. The navy yards, in their present crowded condition, are thus relieved of a great deal of work, and under this new arrangement owners also are assured of immediate pay-

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ment for their boats, dispensing with the time-consuming formalities which ordinarily are followed in dealing with the Government departments. The International Mercantile Marine Company is also supervising all alterations above and below decks, arming, outfitting, coaling and provisioning the ships and delivering them, painted in war colors, to the Navy Department for sea duty. The Special Board for Patrol Vessels is acting in an advisory capacity and is preparing to man all these ships promptly. Such well-known yachts as *Carola IV, Nokomis I, Emeline, Wanderer, Corona, Zara, Remlik, Sialia, Alcedo,* have already been taken over by the Government and are in process of alteration.

There is at present before Congress a bill authorizing the requisitioning for this special sea service all available boats of suitable size and other qualifications, but before this law becomes effective the Special Board for Patrol Vessels and the International Mercantile Marine Company would be very glad to hear from any yacht owner who cares voluntarily to offer his craft for service against the enemy. The work to be accomplished is of an extremely important military nature, so that any owner placing his boat at the disposal of the Government will render the greatest possible service, and, owing to the arrangement with the International Mercantile Marine Company, will receive payment without delay or formality.

Yonkers to be Developed into a Modern Port

The city of Yonkers, N. Y., is preparing to have a modern port terminal equipped with up-to-date harbor facilities and mechanical appliances. Mr. H. McL. Harding, formerly consulting engineer of the Port of New York and now consulting terminal expert for the Barge Canal Terminals of the State of New York and president of the Society of Terminal Engineers, has been appointed consulting engineer to prepare plans and designs.

Yonkers has about 4½ miles of linear waterfront now partially developed, which, when fully improved by diagonal piers, will give at least eight miles of ships' berths. When a port is not equipped with freight-handling machinery about 150 tons of freight per linear foot per year is the average transferring capacity, but when properly equipped 450 tons per foot can be transferred. This increases the workable value per linear foot by three, and is equivalent in results to extending the frontage by three, or the eight miles of ships' berths at Yonkers equipped with freight-handling machinery would be equal to twenty-four miles of the usual waterfront. Waterfront space in the United States is rarely furnished with mechanical facilities, while every port in Europe, small or large, has traveling gantry cranes supplemented by other machinery.

Quays will at first be developed on the unit system, whereby each length of approximately 500 feet will constitute a unit, and thus will have a frontage with a concrete quay wall. There will be close co-ordination between the ships and cars, the railway tracks being parallel to the water's edge. The holding traveling gantry cranes will span the space for these railway tracks and drayways. The holding sheds will be of steel, and not only in front but behind the sheds, between the sheds and the six-story concrete warehouses, will be additional car tracks and drayways, and back of the warehouses the connecting railway tracks and the marginal way will afford connections between all the units of the terminal and the tracks of the main trunk lines.

As the waterfront of Yonkers is but an extension of the shore line of the Port of New York, there will be a continuation of quay and piers, but with this difference—the Yonkers waterfront will be thoroughly modern in design and equipment.

Submarine and Airship Base Sites on the Pacific Coast

The Secretary of the Navy has made public the recommendations of the Commission on Navy Yards and Naval Stations relating to the selection and development of submarine and aviation bases on the Pacific coast.

The commission recommends that San Diego be developed as the main training station for aviation on the Pacific coast, that all or any portion necessary of North Island, in San Diego Bay, be acquired for this purpose, and that $500,000 be appropriated for development, in addition to the amount found necessary for the acquisition of the land. Stating that it has been unable to obtain satisfactory information as to the value of the property and that the owner in a letter named $4,500,000 as the purchase price, the commission adheres to its former recommendation that the Secretary of the Navy be authorized to obtain this site by condemnation or by such other proceedings as may appear advisable after determination of the Government's interests in the property. For the development of an operating submarine base at San Diego, to be located upon the existing naval reservation, and capable of accommodating at one time at least six submarines, it recommends that $375,000 be appropriated.

The commission repeats its previous recommendation that the Secretary of the Navy be authorized to accept a tract of 166 acres of submerged land in Los Angeles harbor, known as site No. 1, which has been offered to the Government free of charge by the city of Los Angeles, and now recommends that $2,500,000 be appropriated for the development of a submarine base on that property. It is also recommended that $250,000 be appropriated for the establishment of an aviation operating base on this same property at Los Angeles.

The commission has received from the harbor engineer of Los Angeles a statement that the value of this site which the city offers to donate free of cost for naval purposes will be $4,000,000 when it is reclaimed, and, further, that a saving of from $400,000 to $500,000 would be effected by the Government in the actual preparation of the site if acceptance be made immediately.

The commission states that general plans and estimates for the development of a home base for submarines and an aviation station at Mare Island Navy Yard, Cal., have been worked out, and it recommends that $490,000 be appropriated for the development of the submarine base and $540,000 for the aviation station.

Plans and estimates for the development of a home base for submarines and an aviation station at the Puget Sound Navy Yard, Wash., have also been completed, and it is recommended that $1,425,000 be appropriated for the submarine base and $375,000 for the aviation station.

For the development of a submarine and aviation operating base on Ediz Hook, opposite Port Angeles, Wash., on ground already owned by the Government, it is recommended that $300,000 be appropriated.

For the establishment of a submarine and aviation base near the mouth of the Columbia River, the acquisition of a site and its development, the Commission recommends that $1,200,000 be appropriated and that legislation be enacted authorizing the acquisition of such site as may be recommended as most suitable by the commission and approved by the Secretary of the Navy and the President.

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LETTERS TO THE EDITOR

Sources of Information

Due to the lack of practical experience of the majority of ships' draftsmen, and their lack of knowledge of costs that is to definitely determine between alternate methods of construction, the following editorial from *Engineering*, October 6, 1916, on Mackrow's "Pocket Book," gives the viewpoint of editors of a plan by which draftsmen may be supplied with this necessary information.

"To the present writer it has always seemed that, while the information contained in the Pocket Book under review is exceedingly comprehensive in its variety and scope and of the highest utility to the draftsman and designer, there is room for an extension of its sphere of usefulness in the direction of pointing out the practical considerations which should underlie and govern good design. Too often it is found that plans issued from the drawing office to the yard are drawn out with little or no regard being paid to the practical difficulties or cost of the construction shown. Inaccessibility for riveting or calking, or for subsequent cleaning and painting, are very common forms of this trouble. Reduction in the amount of smithed angle or furnaced plate work is another point too frequently lost sight of by the designer, with consequent increase in cost of labor and loss of time in the yard or shop. It may be contended that this does not properly come within the scope of a pocket book, but the fact that a copy of Mackrow is to be found in every drawing office, and is, indeed, regarded by draftsmen as almost part of their equipment, is the best proof of the suitability of this medium for distribution of information of the nature suggested. Such information is occasionally to be found in text-books, but these are not generally available, and it would be of great value to have it included as an addition to the book.

"Data regarding oiltight and watertight packings and injection compositions, modern composition substitutes for wood decks, new types of boat davits and life-saving rafts, acetylene and electric arc welding and other points that readily suggest themselves to the mind and which would be of very great service to the shipbuilder, would add to the value of the book and might, in the opinion of the writer, be advantageously inserted in place of some of the tables of dimensions of blocks, hooks, etc., or Lloyds Rules for masts and rigging."

The foregoing comment points out the necessity of such information, but the suggested source of information covers a very limited scope. It is believed that as equipment is entirely dissimilar in every yard, the idea of hard and fast rules being established for methods of construction hardly seems feasible. Methods soon become antiquated and it is not likely that the author of a hand book should care to go on record as to published methods until the next revision of the book. There is a medium, however, through which matter of this kind may be presented, and that is through a magazine; contributions from this source will be received from all connected with shipbuilding and not confined to a few; the tendency, then, is to keep the readers (which should be all whose work has any bearing on maintenance, cost, construction, and design) constantly posted as to improvements. A hand book may contain many practical suggestions as to alternate methods of construction, but to realize the lowest cost and overcome the practical difficulties that arise in each design, the best available mechanic should check drawings before they are sent into the yard. Who is better fitted to criticise and offer suggestions as to ways and means of overcoming these difficulties than the man who has fitted ungainly tuck and boss plates, set up on holding down bolts when the nuts always seem to foul the fillets of angles, and hammered tight-fitting flanged plates that should have been angle connected?

An outside man checking drawings establishes the link in an existing gap between the yard and drawing room whereby the draftsman's information and references (past plans of similar work) are soon brought up to a standard of best practice.

Balboa, C. Z. WILLIAM M. KENNEDY.

The Marine Oil Engine

In the June, 1917, number of MARINE ENGINEERING were two very interesting articles on the oil engine, one on page 244 entitled "Largest American Marine Diesel Engine Installation Proves Successful," and the other on page 261 entitled "Relative Failure of the Marine Diesel Engine."

It would be interesting to know who authorized this statement of the successful operation of the engine covered in the first article. At the bottom of the page we read: "The only defect that has developed has been the cracking of some of the cylinder jackets, which is apparently due to lack of sufficient clearance between working liners and jackets." It is my understanding that this two-cycle type of engine has been removed from European vessels for just this sort of success. It is hard to see how an engine in which castings crack in five months' service can be called successful.

About all that there is of note in the second article is the reference to high pressures. The necessity of high pressure has been shown to be a false theory. Yet here we have the same point cropping out again. We see the cylinders compared to cannon barrels. Heavy oil can be ignited on pressures of compression not far from 100 pounds. In fact, I have a card in my possession where ignition occurred at 70 pounds.

Interesting developments in the oil engine field have been promised within a few months. It is hoped that the design used for the basis of this new start will not be a German design, neither will ordnance firms have to design the cylinder.

Quincy, Mass. JOHN F. WENTWORTH.

What Makes the Gasoline Engine Stop?

SPARKSVILLE, June 9.

Gents: The gas engine you sent me stops when theres nothing the matter with it thats the trouble. It wouldent bee so bad if it stopped for some reason and anybody knows theres reasons enough for it to stop. and why cant it pick out one of them reasons for stopping instead of stopping for no reason at all so that no one cant find the reason because you cant find the reason can you when ther aint no reason thats common sence aint it.

I received the book which you sent me which is named What Makes the Gasoline Engine Go. I aint read it yet be-cause whats the use reading it when I dont care what makes the gasoline engine go as long as it goes which mine dont only occasionally when not particularly needed but when just experimenting or something. what I want to know is What Makes the Gasoline Engine Stop. if you got a book called that send me one and thats what I want to know particularly what makes my gasoline engine stop when everything is o k and nothing is the matter except that it must be a rotten engine.

HIRAM DIGGS.

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The Future of American Shipbuilding

Present Activity Marks Beginning of Permanent Expansion of American Shipbuilding Industry—Trained Men Required

BY ARTHUR F. JOHNSON

THE unprecedented activity in American shipbuilding, with attendant prosperity and investment of capital, will if appropriately carried forward mark the beginning of a permanent and extensive future prosperity for the industry.

The enormous expenditures involved in the new and modern equipment, the affiliation of numerous yards, their intimate relations with or actual domination by the larger steel firms, the education of an immense force of laborers and the awakening of national interest and realization of the blunders committed in the past, all heighten the probability of shipbuilding becoming a prominent future calling in this country.

We cannot build up such a tremendous structure for immediate profit and overthrow it at will, returning to former ways and conditions. Financial ventures of such character have proven themselves inadvisable and will no longer be tolerated. Shipbuilding cannot be considered a "war bride" while we have the knowledge that it can be successfully conducted when peace is declared.

Regardless of excess cost in materials and labor, scientific management will surmount the handicap of foreign competition, as it has done in so many of our other large manufacturing industries. That there will be competition is undoubted, but it is likewise certain that foreign labor will demand increased compensation to offset the burden of taxation imposed to meet expenses in the present conflict.

Certain it is also that many of the yards created here to meet the emergency will be forced to shut down when the demand for new tonnage returns to normal. This will not be immediately upon declaration of peace, however, nor within several years subsequent thereto. It will occur only when the total destroyed tonnage has been replaced and the requirements for new ships can be met by a proportionally decreased number of shipyards.

Efficiency of Shipyards Will Increase

The efficiency of our established shipbuilding plants is marked, but there is no reason to negate its possibility of increase. We are now admittedly building ships more rapidly than England, and such admission on the part of the world's greatest shipbuilding country is a compliment to American system.

If we are to build ships at a profit when orders are no longer so plentiful, account must be taken of the constant or increasing cost of labor, to offset which methods must be improved, number of laborers employed reduced by substitution of machinery where possible, standardization in degree compatible with progress introduced, and the whole industry conducted on strict principles of scientific management.

The accomplishment of these ends would have been practically impossible before the present ship shortage made itself felt, principally because of the traditions connected with ships and their method of building. The profession is one of the oldest and its products are operated apart from observation of the builders by a distinct group, the seafaring men. These limitations of environment prohibit the discussions between builders and operators for purposes of improved design, resulting in adherence to many needless and expensive details in construction.

The building of ships scientifically calls for elimination of every feature tending to increase cost and needless complicity of construction. Furnacing and bending of plates and shapes must be minimized, as must the introduction of many features whose sole merit is the so-called "improvement of the vessel's appearance."

A feature even more important is the recognition of the profession of naval architecture. The scientific production of vessels will call for a maximum of technical talent. The word "technical" here does not imply theoretical only, but practical as well. In fact, the ability to temper theory by limitations of practical consideration is the true measure of a technical man.

Education of Naval Architects

The educational methods at present followed by us must be modified to produce the men who will be best fitted to organize and operate the shipyards in the future, when confronted by keenest competition. That such changes are desirable is testified to by the justifiable reluctance evinced by many firms toward the employment of newly graduated technical men, the reasons for which are twofold.

Primarily the graduate's attitude toward the profession is too theoretical and often he hasn't the least conception of practical shipbuilding as conducted in the yards. When first taken into the company's employ he must revise his ideals and accustom his mental attitude to the limitations imposed by practice. His knowledge makes him best fitted for employment in the drafting room or mold loft, calculations being his hobby. Even here his first year or two is at the expense of the shipbuilding firm.

Secondarily, the graduate is blind to his faults, ordinarily imagining that "science" as applied to ship work began when he received his diploma. He overestimates his assets and underestimates those of the practical men around him. A certain percentage of this latter trait may be attributed to the eternal egotism of youth and can never be suppressed except through experience gained with age. A much larger percentage of it is doubtless due to the academic nature of his college course and could have been avoided by an injection of the strictly practical in moderate amount, a remedy possible only through co-operation between shipbuilding firms and the faculty members.

Another explanation, and this of the antiquity of some of the small amount of the student's practical knowledge, is that texts are necessarily somewhat behind in methods treated of, having been written only to cover standard practice, and that in most general terms. There is no thorough treatise on the practical art of shipbuilding as conducted on this side of the Atlantic, and the only feasible plan to afford the required information would be by direct study of the yards in proximity to the technical school.

A university or technical school is not conducted with a view to financial gain, and the proper furtherance of its courses necessitates employment of elaborate equipment, the expense of which cannot be covered by tuition and incidental charges. To attempt this would render charges

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of magnitude prohibitive to registration of the majority of the students anticipating a technical career.

Most technical students are of moderate means, in direct opposition to the prosperous majority of those undertaking academic courses. The irony of this relation is enhanced by the fact that the expense of maintaining a technical course is much greater than that in the case of an academic one.

Much of the present equipment in technical school laboratories has been generously provided, through direct contribution or considerable reduction in price, by the manufacturers. The shipbuilding firms of this country should take an active and collective personal interest in the laboratory equipment of our schools in naval architecture and marine engineering, and such action should not be considered in the nature of unprofitable investment. They must not anticipate a corps of graduates fitted to step into their concerns, and promote their welfare, unless those concerns put forth every effort to promote the efficiency of the technical courses.

Such conduct applies in equal measure to the faculty of each technical institution. Those responsible for instruction of future naval architects must not stand aloof from personal and ceaseless effort to govern the dissemination of information by the ever-changing requirements as set forth by progress of the industry.

Co-operation of Schools and Shipbuilders

One of the prominent schools in naval architecture has started work along these lines by soliciting the advice of prominent shipyard executives. The same generous men would, it is felt, serve in similar capacity every like institution in the country. There are not many such schools and they are well distributed geographically. It is but a question of approaching the leading shipbuilding firms, who will gladly put forth every effort to advance the profession. Their advice is essential, and their gain would be considerable, if each institution were properly equipped to conduct tests and investigate problems of direct practical value to the industry. Many vexing and expense-increasing obstacles are constantly encountered in the shipyards, to which the firm cannot devote time, but which could be quickly and efficiently eliminated if referred to the laboratory of the nearest school in naval architecture.

The experience gained by students solving these difficulties would put them in closer touch with actual working conditions and render them better fitted to step into harness upon graduation.

If the various shipbuilding firms would constitute themselves into groups centered about the institution closest to their plants, each group to be represented by a committee which would include representatives of the faculty, much could be done toward improving the conduct of both plants and institutions.

The period of so-called "trade secrets" has passed, and with it the false standards of efficiency set up by adherence to a fixed procedure closed to outside suggestions for improvement.

The personnel of future technical men and their derivation are worthy of careful thought. Many youngsters entering a course in engineering have not the remotest idea of its purposes and scope, which accounts for the numerous failures to complete the course or, in event of graduation, the big percentage of those who make little or no progress. A requisite for success in engineering is the ability to create, to foresee possibilities, to eliminate wasteful conditions and to conserve energy.

If a larger percentage of engineers were recruited from the brighter youths employed in industrial plants, the profession would be benefited, for, having seen the practical workings of the industry, these youths would be in position to gage their interest in it as a life vocation, and thus obviate the waste of years, and possibly a lifetime, in a calling unsuited to their particular temperament.

If the larger and permanent shipbuilding companies were to establish scholarships at the schools of naval architecture and marine engineering, financing the project by loan to the students or through a fund with the university, and selecting candidates from the youths in yard, shop and drafting room by competitive marks and tests, the esprit du corps would be elevated and a higher class of men would seek affiliation with the industry. Another of the numerous advantages of such procedure would be the development of technical men suited for work outside the drafting room or mold loft.

The shipbuilding industry in this country is well advanced, considering its besetting difficulties in previous normal times. An avoidance of similar conditions after the present boom can be brought about only through the most efficient and farsighted procedure. It will prove advantageous for us to seriously consider some program in essence here outlined, with the added feature of graduate student courses as conducted by the large manufacturing companies in this country.

Steamboat Inspection Rule for Licenses Is Modified

Telegrams have been recently received by the Board of Supervising Inspectors of the Steamboat Inspection Service of the Department of Commerce, from towboat and tugboat owners of Puget Sound and other western points, urging that some action be taken relative to modifying the rules as to admission to license of masters, mates and assistant engineers of craft plying such waters. The telegrams stated that owing to high wages being paid by the navy yards and shipyards, it was impossible to keep licensed mates and engineers. They could get from $6 to $9 per eight-hour day and overtime, and the result was that it was becoming increasingly difficult to obtain enough men to operate their craft.

After considering this matter, the executive committee of the Board of Supervising Inspectors issued the following order: That for the present and until further notice, sections 20, 21, 23, 26, 31 and 32 of Rule V, General Rules and Regulations Applying to Lakes (other than the Great Lakes), Bays and Sounds, be struck out and local inspectors notified that hereafter in issuing licenses to officers of vessels within this classification, they may exercise the judgment and discretion vested in them by law, without regard to the experience required by the rules and regulations, the sufficiency of such experience to be determined by the local inspectors when a candidate applies for examination.

The effect of this order, which has been approved by the Secretary of Commerce, is to modify the rules for experience and make it much less difficult to obtain a license. In other words, if the local inspector considers a man qualified to stand the examination but is lacking in experience, he may examine him.

The order affects masters of steam vessels in the territories indicated, and also mates, pilots and chief and first, second and third assistant engineers. The order applies to Chesapeake Bay, the Potomac River, Long Island Sound, Delaware Bay, Pamlico and Albemarle Sounds, Mobile Bay, Lakes Ponchartrain and Maurepas and other sounds and coast waters.

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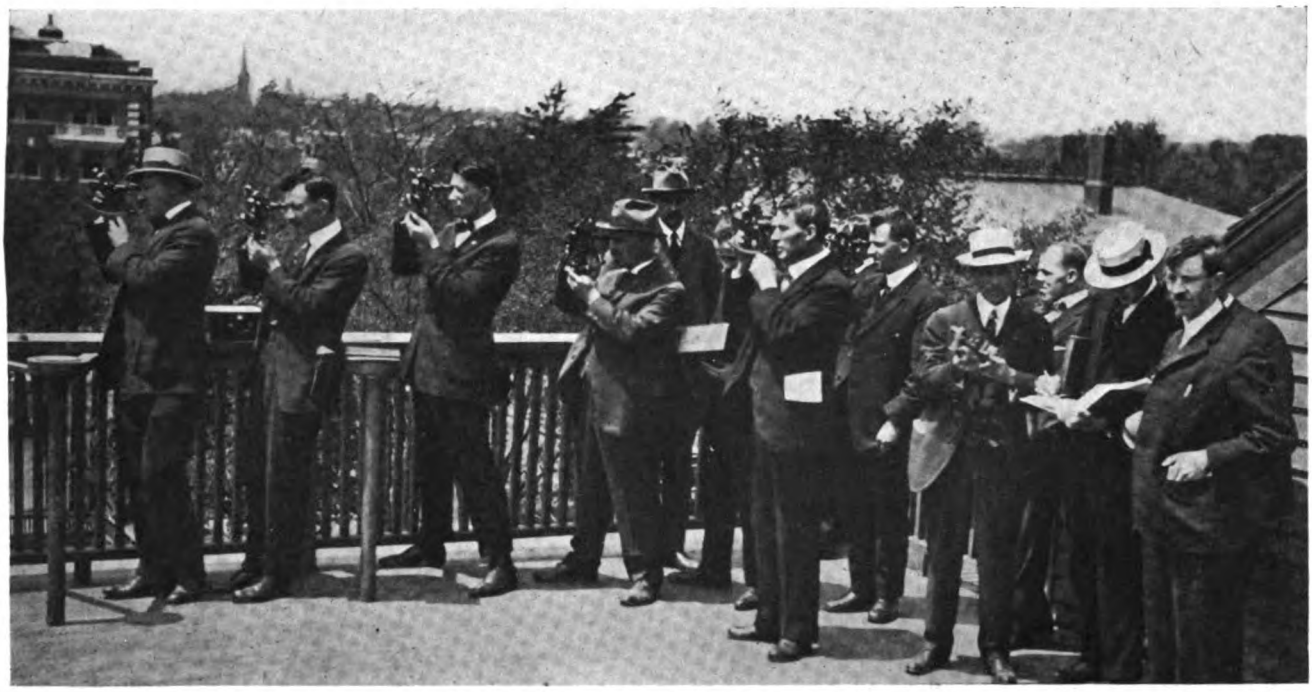

The first class in Uncle Sam's chain of navigation schools to prepare officers for the merchant marine. This school was opened at Harvard College, June 4. Others are being opened at Atlantic Coast ports. Later the Gulf and the Pacific Coast will have similar schools. Not less than 5,000 deck officers for the new blockade running fleet of 1,000 merchantmen will begin their training in these schools

A Call to American Seafaring Men

Navigators and Engineers Wanted for the United States Emergency Fleet—Training Provided by the Shipping Board

A CALL to American seafaring men, in behalf of the Merchant Marine, has been issued by the National Government through the United States Shipping Board. The Government wants the services of every man now free to enroll who can qualify as a watch officer or has a fundamental knowledge of engines or engine room duties. It will need in a few months 10,000 officers for the large fleet of cargo ships to be constructed for the Shipping Board. These ships are to be the nucleus of a new, nationalized fleet that eventually will carry the flag to every quarter of the globe and put the country where it belongs—among the maritime nations of the earth.

This fleet is actually under construction, and the fact that the construction work has been entrusted to Major General George W. Goethals, the man who dug the Panama Canal after it had broken the purse of its French backers and the hearts of many trained engineers, is evidence that the job will be completed as planned.

Pressing Need for Men

The Government's most pressing need for its new fleet is not, in fact, ships, for those are assured, but men. There are not 10,000 merchant officers in this country, nor yet 5,000. But there is the raw material for officers at every American port.

Americans are notably adaptable, and on this fact the Government bases its faith that the officers needed to supplement those now in service can and will be found among the hosts of clean, dependable, intelligent men not enrolled in the navy, who know something of the water. In every port of the United States one sees such men on board small craft of every sort—on tugs, ferryboats, passenger steamers plying harbors, lakes and sounds, or sailing vessels, both coasters and fishermen, and in the crews of larger coastwise steamers.

Class of Men Wanted

Most of them occupy modest positions. A good many have never dreamed of command on an ocean-going ship or of a berth as a first officer or engineer on such a ship. They have not enough faith in themselves, perhaps, for want of encouragement, to believe they could make good in such a position of responsibility.

But Uncle Sam thinks they can make good. He is telling them so by every means possible, as fast as he learns where they may be reached. In order to impress on them their value to their country at this time, and the welcome they will receive in the new merchant marine, he has established a recruiting service for the Shipping Board.

At the head of this service has been placed a trained organizer, Henry Howard, of Boston. Mr. Howard, who is a business man and a yachtsman, is entirely familiar with the needs and traditions of the merchant marine.

Mr. Howard advanced to the Shipping Board a few weeks ago a comprehensive programme for utilizing the country's splendid material for merchant officers. Having a perfect knowledge of the coast and conditions in maritime communities, he told the Board that there were enough men of the best type available to officer the new ships being built for the Board by General Goethals, and

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all others now building that the Government may take over.

The Board heard Mr. Howard's statement with receptive interest, authorized him to go ahead and made him director of recruiting for the Shipping Board, with full powers to enlist and train the 10,000 officers that the Board ultimately will need. Since taking office Mr. Howard has made a widespread appeal to recruits through the daily press and class papers read by the type of man he wishes to reach.

Already a large number of recruits have come forward for positions, sending their names to Mr. Howard's headquarters, which are at the Custom House, Boston. As fast as names come in they are filed and each applicant, if he has had seagoing experience of three years, is sent information of the plan to be followed in fitting applicants for service.

Instructors in School of Navigation. To the left, H. W. Geramanos, Dean of Engineering School, North Easton College. To the right, Prof. G. L. Hosmer, Harvard

The Government does not ask the applicant to plunge unprepared into the work reserved for him. It is ready with a practical means of aiding him to fit himself for the new job. These means consist of schooling and training, the expense of which the Government takes upon itself.

Training Proposed by Mr. Howard

A system of training was outlined in Mr. Howard's original proposal to the Government, and it is now being worked out at various points on the Atlantic Coast, in so far as it applies to candidates for places as watch officers. It is planned to open schools for engineer officers later in the year.

Each applicant for a place as a watch officer is informed that if he has had the proper seagoing experience he will be given a course in navigation under skilled instructors at any one of the following points which he may designate: Cambridge, Mass (Harvard College); Machias, Rockland, Boothbay Harbor or Portland, Me.; New Bedford, Mass.; Greenport, Long Island.

The teaching staff distributed at these points is under the direction of Dean Alfred E. Burton, Professor of Topographical Engineering at the Massachusetts Institute of Technology, who is a practical navigator and a former member of the Coast and Geodetic Survey. Beginning their work with class room lessons, the students are soon taken afloat on yachts or other boats provided by the Government, and are given opportunity to pursue their work under actual conditions required for finding a ship's position at sea with the use of instruments.

As soon as the students are ready for their examinations, they will be examined by representatives of the Steamboat Inspection Service, and under the rules governing the granting of papers for officers of ocean-going vessels, will be given their certificates.

First Student to Enlist, Melvin H. Fowler, of Chelsea, Mass., a Native of Cherryfield, Me.

Preliminary Service of Recruits

Unless fully qualified by seafaring experience to take a position of full responsibility at once, they will be placed for training at sea as junior officers on coastwise vessels, or those in the South American trade, and will go on pay, probably at $75 a month, for the period that they are to serve in this way. The ships to which they are assigned will carry their full complement of officers as usual, and the new juniors will stand watches with them, thus gradually working into the way of taking charge of the deck on their own account.

As the new ships come out—and the first of them will be overboard inside of six months—officers for them will be chosen in part from among the men thus trained. A man then goes on full pay for his grade at the going war rate for the transatlantic service. At present that totals, with war bonus, about $350 a month for captains, $250 a month for first officers, and in proportion for second and third mates.

It will be seen, therefore, that Uncle Sam offers a lavish inducement to men with a knowledge of seagoing to come forward and help break the power of the predatory Germans on the sea. At this writing it appears that this

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power is diminishing, but the United States Government is placing no reliance on chance, and is preparing for eventualities on a scale aimed to nullify the submarine menace, however great it may grow to be. There is no doubt in the minds of men conversant with the plans of the shipping board that this can be done in the way that Uncle Sam is starting out to do it. His plan in essence is to put his cargoes in so many bottoms that only a fraction of them can be sunk by the German submarines at their best. The rest will get through, with the consequent assurance of a steady stream of supplies for the Allies and for our own gallant boys in France. That, as the Government sees the situation, means the ultimate wearing down of the Hun, for he has himself said that his reliance is the submarine. Blockaded, with his food supply limited and steadily diminishing, with his rolling stock worn out or tied up for want of lubricants, with discontent growing among his deluded subjects, who have been fed upon false reports of victories, the Kaiser will find himself spent by mere attrition of his forces.

VALUE OF MERCHANT MARINE SERVICE

Therefore, says the Shipping Board, the man who steers a cargo of supplies through the submarine zone is as mighty as an army with banners. He is indeed the army, for he has the army's stomach in his keeping. Therefore the Government expects every man who feels in his heart that he can do something for his country on the sea, to drop his oar or wheel or monkey wrench and come forward, sending his name to Henry Howard, Custom House, Boston, as fast as wire or mail can carry it.

When the war is over, according to shipping experts, the United States perforce will be one of the leading shipbuilding, as well as one of the leading shipowning, nations of the world. The logic of the situation is all in that direction. For these reasons the positions which Uncle Sam now offers his sailor sons may become permanent ones. The flag will fly on the sea in the next generation as it has never flown before. Confidence of this is in the air at Washington.

In the past two months there has been much discussion in the press on what appeared to be a controversy between Shipping Board officials on the merits of wooden and steel ships for the new blockade-running fleet. Chairman William Denman, of the Shipping Board, favored the building of as many wooden ships as possible, for immediate use. General Goethals, speaking at a dinner in New York, remarked that the birds were still nesting in the trees that would go into wooden ships. He emphasized the limitations on wooden shipbuilding, through want of material, yards and labor. Others have pointed out that many of the famous New England yards had fallen into disuse when the war began. The old race of shipwrights had died. Their sons did not follow the trade of their fathers.

THE WOODEN FLEET

This was all true, yet it did not alter the fact that a certain number of wooden ships could be built, and several have been contracted for. While not as permanent as steel vessels, these wooden ships show a sturdy design, and one that indicates years of service. They are about 3,000 tons register and not unlike the old wooden revenue cutters, which did service on the American coasts for generations and even braved the pressure of Arctic ice without straining or leaking. A considerable number of these vessels are taking shape in the New England yards and elsewhere. The constructor in charge of the work in New England is William H. Hand, Jr., of New Bedford, a practical naval architect, who developed the now well-known V-bottom type of power boat. Mr. Hand has faith in the wooden ship as a means to an end. "When you want a club to beat off a mad dog with you are not particular what kind of a club it is, if it will do the work," says Mr. Hand privately, and in that remark lies the logic of the wooden ship.

Of steel ships the emergency fleet will be composed in the main. They will be stout, effective boats of about 8,800 tons deadweight, perfectly adapted to the work they are to do. Within six months one of them will take the water every day in the month; within a year, two.

The German ships, which are being fitted out for service by the Shipping Board, present a different angle of the programme. Many of them are passenger vessels, with no cargo capacity worth counting. These will be used as troopships, without much doubt, and though they aggregate 600,000 tons register, their acquisition does not lessen the need of speedy and effective action, such as is now going on, for the building and manning of Uncle Sam's emergency fleet.

Recruiting Battalion of Service Men

The recruiting committee of the New York Mayor's Committee on National Defense has organized the Recruiting Battalion of Service Men, to be made up of two thousand men who have worn their country's uniform in any branch of the regular service, the National Guard and the Naval Militia. These men, in squads of five to twenty, will address and give out information to numerous audiences throughout the city of New York. The recruiting committee earnestly appeals to every man who has worn the country's uniform to send to its secretary, Lewis K. Brown, 50 East Forty-second street, his name, business and home addresses, with telephone numbers, and an offer of service for one night a week on the recruiting battalion. It also requests that political, civic, fraternal, trade and social clubs, unions and orders, where members are largely of enlistment possibility, offer meetings for this purpose.

Coast Guard Cutter McCulloch Sunk in a Collision

The Coast Guard cutter *McCulloch*, one of the oldest vessels in the Coast Guard service, was sunk in collision with the passenger steamer *Governor* off Point Arguello, Cal., on June 13. The accident occurred in a dense fog and no casualties resulted. Since the beginning of the war the *McCulloch* has been patroling the California coast. During the Spanish-American war the *McCulloch* participated in the battle of Manila Bay.

Coast Survey Steamer Patterson Strikes Rock

The Coast and Geodetic Survey steamer *Patterson*, which left Seattle, Wash., on April 25, arrived at Juneau, Alaska, on May 10, and proceeded to its field of operations in Cross Sound and Icy Strait. On May 24 word was received that the steamer had struck a rock, carrying away its rudder and injuring its bottom. A later report stated that the vessel was leaking and that the rudder was injured beyond field repair. On May 28 the S. S. *Explorer* was directed by wire to go to its assistance from Ketchikan. Repairs will be made at Juneau if practicable, in order that the vessel may resume field work promptly.

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Standard Wooden Steamships for United States Shipping Board Emergency Fleet

Plans and Specifications of Standard Type, 3,500-Ton Wooden Cargo Steamer Designed by Theodore E. Ferris, Naval Architect of United States Shipping Board

SUPPLEMENTING the brief description of the standard type wooden cargo steamers for the United States emergency fleet given in our June issue, we print herewith complete plans and more extended extracts from the specifications of these vessels. These plans have been worked out by Theodore E. Ferris, naval architect, 30 Church street, New York, who has been appointed official naval architect for the Shipping Board.

The principal dimensions of the ships are as follows:

Length overall	281 feet 6 inches
Length between perpendiculars	268 feet
Beam, over planking	46 feet
Depth, molded at side of upper deck	26 feet
Load draft from bottom of keel shoe	23 feet 6 inches
Total estimated deadweight	3,500 long tons
Sea speed, loaded	10 knots
Indicated horsepower	1,400

The estimated weights of the standard wooden ships as furnished by the naval architect are as follows:

ESTIMATED WEIGHTS

Item	Yellow Pine Ship Long Tons	Douglas Fir Ship Long Tons
Wood in hull	1,677.0	1,827.0
Fastenings	142.4	145.7
Anchors and cables	31.4	31.4
Paint and calking	10.0	10.0
Forgings and castings	35.0	35.0
Hull piping and machinery	50.0	50.0
Two guns	7.0	7.0
Miscellaneous outfit	27.2	27.9
Total hull weight	1,980.0	2,134.0
Propelling machinery	275.0	275.0
Deadweight	3,625.0	3,421.0
Displacement at 23' 6" S. W.	5,880.0	5,830.0

These figures for the wood hull are based on bills of material after deducting scrap, and for lumber of about 18 percent moisture. Green lumber well weigh about 12 percent more.

General Arrangement

The vessel is of the single deck type with hold beams and shifting 'tween decks with wood deck houses on the bridge and poop decks. The vessel has a straight stem and elliptical stern and is fitted with two wood pole masts, fitted with cargo booms, and one smokestack. Four cargo hatches are provided in the upper deck and a small hatch in the poop deck.

Four calked watertight wooden bulkheads extend to the upper deck, forming two cargo holds and the machinery space. There is a deep tank forward of amidships for water ballast and also water tanks for boiler feed. Culinary water will be carried in separate steel tanks located in the engine room. The after peak is piped for fresh water for boiler feed and for salt water for the trimming tank. The fore peak is piped for fresh water only. Steam winches are fitted at the hatches for working the cargo booms.

The amidship deckhouses on the bridge deck contain the officers' quarters, chart room, wireless, gunners, quarters for petty officers, engineers, cooks, oilers, messmen, etc. The bridge space is used for coal or cargo and a part of the poop space for stores or cargo. Awnings will be fitted over the bridge abreast the wheel house, over the boat deck between the officers' house and wireless house, abreast of the officers' house, abreast of the steering house, and around the stern at the poop deck.

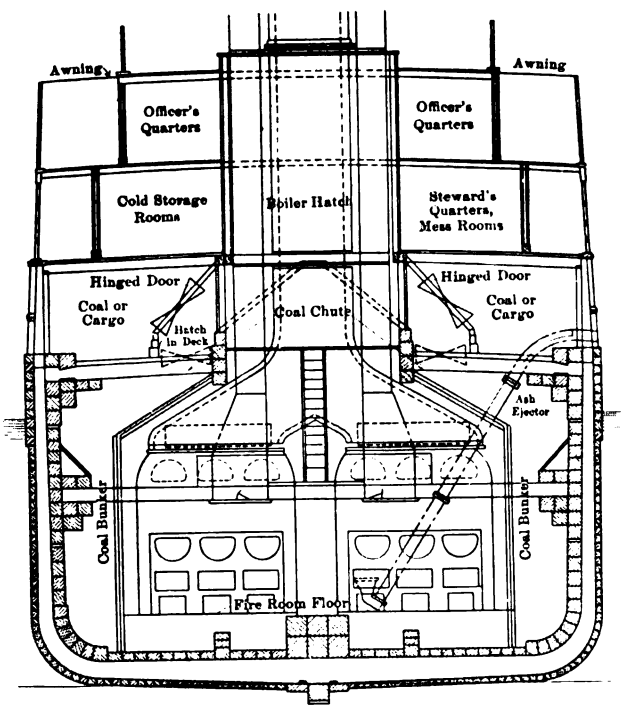

Fig. 1.—Section Through Boiler Room, Looking Aft

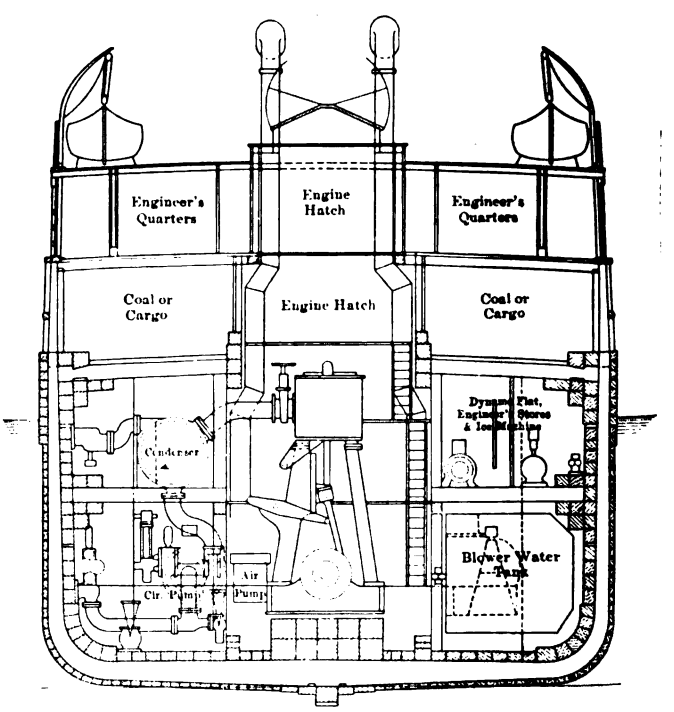

Fig. 2.—Section Through Engine Room, Looking Forward

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STANDARD TYPE WOODEN CARGO STEAMSHIP

Designed by Theodore E. Ferris, Naval Architect, New York

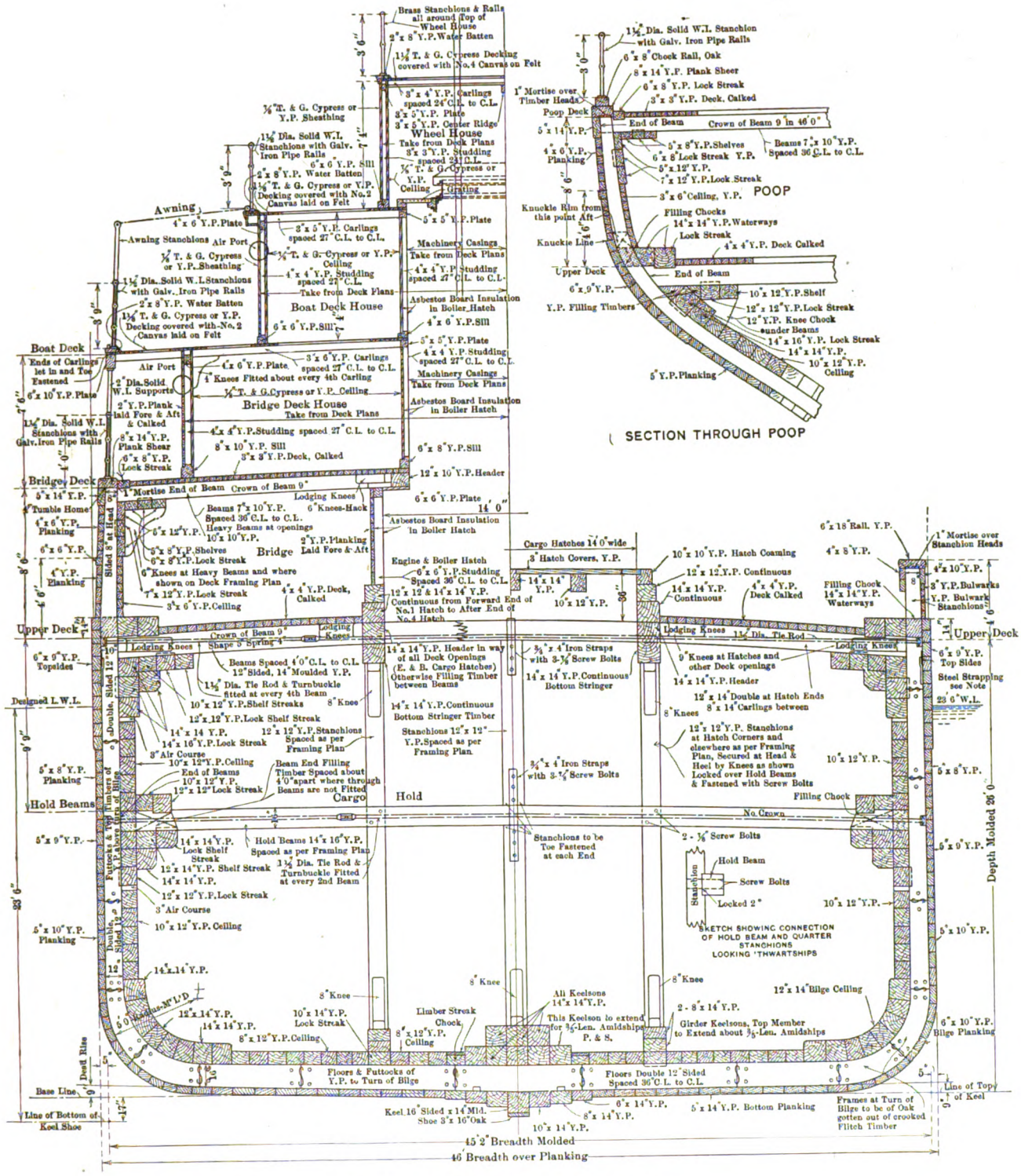

Fig. 6.—Midship Section, Showing Scantlings

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PROPULSION

The propelling machinery will consist of one triple expansion engine; two single-ended Scotch boilers or water-tube boilers fitted with heated forced draft for coal burning with one fire room, together with all necessary auxiliaries, electric light plant, steam winches, warping capstan, steam windlass, steam and auxiliary hand-steering gear, ice machine, steam heating system and complete drainage system. Twin screw reciprocating or geared turbine steam propelling machinery may be substituted for the single screw propelling machinery, subject to approval of the owners.

MATERIALS

The timber and lumber used in the construction of this vessel may be either dense southern yellow pine as graded by the Southern Pine Association, or Douglas fir. Specifications for both materials are given, although the following applies to yellow pine, the scantlings for which are shown on the midship section, Fig. 6.

The entire hull will be of yellow pine except the stern post, rudder post, rudder stock, horn timber, shaft log and keel shoe, which will be of white oak. Wood knees will be of hackmatack or oak. Treenails will be of locust or split oak. Joiner sheathing and decks, where specified, will be of cypress.

HULL CONSTRUCTION

The keel is of yellow pine 16 inches by 14 inches, to which is fitted a shoe of white oak 3 inches thick and 16 inches wide.

The stem of yellow pine is sided 16 inches and molded 20 inches. The apron of yellow pine is 16 inches by 16 inches backed up with a second apron of the same size. Both aprons are in one length, extending to the forecastle deck. The stem grip is of white oak sided the same as the stem. The knight heads are of yellow pine sided 20 inches and molded the same as the frames, fayed up to inside the apron. The forward deadwood and knee are of yellow pine sided 16 inches and molded 18 inches, extending from through the floors forward for receiving the heels of the cant frames. The knee is of hackmatack or oak, connecting the keel to the stem grip, and apron 16 inches sided with long arms. The forward deadwoods are of yellow pine sided 16 inches, bedded in between the top keelson and apron.

The outside and inside stern posts are of white oak sided 28 inches in way of the shaft log 16 inches above the keel and at head molded 24 inches. The lower end of each post is tapered to the siding of the keel and to have a tenon 5 by 12 by 14 inches fastened with two 1⅜-inch treenails. Each stern post extends to the upper deck and is fastened to the deck beams. The after side of the outer post is rounded out above and below the stern bush casting for an easy flow of the water.

The shaft log is of white oak built up in four pieces 14 by 14 inches bored out to receive the stern tube. The after deadwood and knee are of yellow pine sided 16 inches and molded 18 inches, extending from through the frame floor aft to the stern post for receiving the heels of the cant frames. The after deadwoods are of yellow pine sided 16 inches, bedded in between the top of the shaft log and inner stern post.

The rudder post is of white oak sided 16 inches, molded 18 inches, to have a tenon in the keel 5 by 12 by 14 inches fastened with two 1⅜-inch treenails.

FRAMING

The rudder stock is of selected best white oak finished 18 inches in diameter. The rudder blade is built up of yellow pine tapered to 14 inches at the after edge.

The main frames are double-sawed of yellow pine. The bilge frames are worked out of crooked oak, straight fir or wide yellow pine, sided 12 inches, molded on keel 18 inches, at turn of bilge 16 inches, at top of bilge 12 inches, at upper deck 10 inches, at bridge, forecastle and poop deck, 8 inches; also at bulwark rail, 8 inches. The frames are spaced 36 inches center to center. In way of the bridge, forecastle and poop, the frames continue up double.

There are eight main keelsons of yellow pine 14 by 14 inches, and on each side girder keelsons of yellow pine arranged as shown on the midship section, the first strake 10 by 14 inches, and the second and third strakes 8 by 14 inches. The first and second strakes are worked the full length between the peak bulkheads, the third or top strake is worked for about three-fifths the length amidships.

CEILING AND PLANKING

The bottom and side ceiling is all of yellow pine. The bottom ceiling is 8 by 12 inches, the side ceiling 10 by 12 inches. One strake of the side ceiling on each side is 12 by 12 inches locked over the frames, as shown on the midship section. There are three strakes of bilge ceiling on each side of yellow pine, 14 by 14 inches, with five strakes between 12 by 14 inches. The garboard strakes are of yellow pine; the first strake, 10 by 14 inches; the second strake, 8 by 14 inches; third strake, 6 by 14 inches.

The outside planking, also of yellow pine, is as follows: Bottom planking, 5 by 14 inches; bilge planking, 6 by 10 inches; side planking, 5 by 10 inches, 5 by 9 inches, 5 by 8 inches; topside planking, 6 by 9 inches. Between the planking and the frames is a system of iron strapping arranged as follows: At the upper deck beams is a top chord, 8 inches by ¾ inch, extending from 12 feet forward of the forward hatch to 12 feet aft of the after hatch. The plates in this chord are connected by triple riveted butt straps and are fastened to each frame by two 1-inch by 10-inch bolts, staggered. Diagonal straps of 4-inch by ½-inch iron, let into the outside of the frames, and inclined at 45 degrees each way, are fitted so as to meet at the top chord in every frame space. The diagonals are connected to the chord by two ⅞-inch rivets at each crossing by one 1-inch rivet. They are also fastened to each frame timber by one 1-inch by 10-inch bolt. The diagonals are to be carried well down and wrapped around the bilge far enough to overlap the ends of the floor timbers.

DECKS

At the upper deck are two strakes of deck beam shelf timbers on each side, 10 inches by 12 inches, one lock strake, 12 by 12 inches locked 2 inches over the beams, and one bosom strake, 14 by 14 inches. The hold beam shelf timbers consist of one strake, 10 inches by 12 inches on each side, and one lock strake 12 inches by 12 inches, while below the hold beams is one strake 12 by 14 inches, one lock strake 14 by 14 inches and one bosom strake 14 by 14 inches.

The upper deck beams are of yellow pine, sided 12 inches, molded 14 inches, worked with 9-inch crown shape 5 inches and spring, 4 inches. The beams are doubled at the hatch and engine and boiler openings. The beams are spaced about 4 feet center to center. In way of hatches and other openings carlin beams are fitted, sided 8 inches, molded 14 inches.

The hold beams are of yellow pine, sided 14 inches and molded 16 inches. They are fitted throughout the hull between hatches and other upper deck openings, spaced about 4 feet centers. Beam and filling timbers, spaced about 4 feet apart, are fitted between the upper and lower shelf timbers where through-hold beams are not fitted.

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STANCHIONS

In way of hatch coamings there are fitted on each side continuous from the forecastle-head bulkhead to the poop bulkhead deck girders made up of two 14- by 14-inch and one 12- by 12-inch timbers, with 14- by 14-inch hatch header and filling timber between through beams. The hatch-end coamings are made up with 14- by 14-inch and 12- by 12-inch toe fitted into the girder timbers, forming the remainder of the hatch coamings, 10 by 10 inches.

Center and wing stanchions of yellow pine, 12 by 12 inches, are spaced and located as shown on the framing plans. The center stanchions are connected to the keelsons with 8-inch wood knees, one stanchion in way of each hold beam, connected at the hold beam with two ¾- by 4-inch iron straps fastened with six ⅞-inch screw bolts; also connected to upper deck beams in a similar manner.

Iron tie rods, 1½ inches diameter with turnbuckles, are fitted in way of the upper beams and hold beams, spaced about every fourth beam.

BULKHEADS

Forward of the boiler room bulkhead extending into the hold is a deep water tank for water ballast, extending up to the line of the hold beams. The bulkhead is of 3- by 8-inch double diagonal yellow pine, with studding of 8- by 12-inch yellow pine spaced 24 inches apart. The center fore-and-aft bulkhead is of yellow pine 6 inches thick with 8- by 12-inch yellow pine studding, spaced about 30 inches apart. These tanks will have a capacity of about 350 tons of salt water. Aft of the engine room bulkhead on each side of the thrust recess, extending up to the line of the hold beams, are tanks for boiler feed having a capacity of about 80 tons of fresh water. The tanks are constructed in the same manner as the deep water tanks. The forepeak tank is arranged for carrying fresh water. The after peak is arranged for carrying fresh water for boiler feed and for salt water for trimming purposes.

Between the engine and fire room is a steel screen bulkhead built of plating 3/16-inch thick, stiffened with 2½- by 2½- by ¼-inch angles, spaced about 24 inches apart. The bulkhead is to fit partly around the boilers and to have a hinged door for passage from the engine to fire room.

FASTENINGS

In the matter of fastenings, the following is provided in the specifications: All fastenings to be equal to the requirements of the American Bureau of Shipping and, in addition, in accordance with the following plans of fastenings: All nail, spike and bolt iron fastenings to be galvanized and all clinch rings galvanized. Screw bolt fastening to be used where necessary. All bolt iron fastenings through yellow pine or fir wood for bolts up to 24 inches in length to be driven with about ⅛-inch drift. For bolts exceeding 24 inches in length driven with drift of 1/16 inch; for bolts through oak, 1/16-inch drift. All bolts driven over clinch rings to be well headed and blunt or drift bolts pointed where necessary. All bolt fastenings in outside planking, waterways, plankshears, rails and weather bulkheads, and all bolt or spike fastenings in weather deck to be plugged with white or yellow pine plugs dipped in white lead paint. The treenails to be of good grade split locust, oak or other approved wood and wedged on both ends across the grain of the wood through which they are driven. As many treenails as possible, at least one-half, driven through and wedged on both ends. Tie rods and screw bolts where necessary set up in large, heavy plate washers.

BOILERS

Steam will be furnished at 190 pounds per square inch working pressure by two three-furnace, marine type, coal-burning boilers, constructed in accordance with the United States Steamboat Inspection Rules and those of the American Bureau of Shipping. Each boiler will be 14 feet 6 inches inside diameter and 11 feet 2 inches long overall. The total effective boiler heating surface will be 4,500 square feet, and the total grate area 105 square feet.

Each boiler will have three independent combustion chambers. The tubes will be 2½-inch outside diameter of charcoal iron lap-welded. Each boiler will be fitted with three corrugated furnaces of the Morison suspension type of 42 inches inside diameter.

The boilers will be located in a single stokehold with a common fireroom, and the products of combustion will be led up a single stack reaching to a height of about 76 feet above the base line.

As an alternative for Scotch boilers, the following watertube boilers will be acceptable: Babcock & Wilcox, Howden, Yarrow or Mosher, with a heating surface of not less than 5,000 square feet. Other types of watertube boilers will be considered, the heating surface to be as approved.

PROPELLING MACHINERY, SINGLE SCREW SHIP

For a single screw ship, fitted with a reciprocating engine, the main engine will be of the triple expansion type with cylinders 19 by 32¼ by 54 inches diameter, with a common stroke of 42 inches. The engine will be built for a piston speed of about 630 feet per minute and capable of developing 90 revolutions per minute with the ship at the load draft. The engine is designed to develop 1,400 indicated horsepower when working under full boiler pressure, with no live steam passing the high pressure cylinder and no live steam in the receivers.

Engines of a size different from the above will be accepted if capable of meeting the desired conditions, as regards indicated horsepower and piston speed.

The framing of the main engine consists of cast iron housings, while the bed plate is of cast iron. The main valves for the high pressure and intermediate pressure cylinders are of the piston type with a double-ported slide valve for the low pressure cylinder. The valve gear will be of the Stephenson link motion with double bar links.

There will be worked off the main engine, by beams, attached pumps consisting of a main air pump and two bilge pumps. The operating platform will be on the starboard side at the engine room floor.

The crank shaft is in two sections of the built-up type, secured by solid forged steel couplings and straight coupling bolts. The piston rods, connecting rods, shafting and working parts generally are forged of open-hearth steel. The crank shaft is 11¼ inches diameter. The line shafting is 10⅝-inch diameter and the thrust shaft 11¼ inches diameter, while the propeller shaft is 12 inches diameter.

The propeller is of cast iron, four-bladed.

Steam from the main engine is exhausted into a single condenser, containing about 2,500 square feet of condensing surface. Cooling water is supplied by one main circulating pump of the centrifugal type with 12-inch suction and discharge and a capacity of 2,000 gallons per minute against a head of 15 feet. The engine for driving the circulating pump is of the vertical type. The main air pump of the Edwards type works off the low pressure crosshead of the main engine. The pump is 22 inches diameter by 18 inches stroke. Two bilge pumps of 3¼ inches diameter by 18 inches stroke are also worked off the low pressure crosshead of the main engine.

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INDEPENDENT PUMPS

Two main and auxiliary feed, 10 by 6 by 12 inches, vertical simplex type. One general service, 10 by 6 by 10 inches, horizontal duplex. One fire, bilge and general service, 10 by 6 by 10 inches, horizontal duplex. One sanitary, 6 by 5¾ by 6 inches, horizontal duplex. One fresh water, 4½ by 2¾ by 4 inches, horizontal duplex. One evaporator feed, 4½ by 2¾ by 4 inches, horizontal duplex.

AUXILIARIES

Located in the engine room is a forced draft fan driven by a direct-connected engine for supplying air for a system of heated forced draft. The fan is capable of handling continuously air for the combustion of 3,000 pounds of coal per hour at a pressure of 2 inches of water at the blower outlet. The fan is driven by a single fully inclosed dust- and moisture-proof vertical inverted cylinder high-speed steam engine.

In the fire room is a 6-inch hydraulic ash ejector operated by water from the fire and bilge and general service pumps.

Located in the engine room is a feed water heater of sufficient capacity to heat 30,000 pounds of feed water per hour from 120 to 212 degrees Fahrenheit when using exhaust steam at 5 pounds per square inch gage. The rise in pressure of the feed water passing through the tubes shall not exceed 20 pounds per square inch.

There is also a feed and filter tank of 800 gallons capacity installed in the engine room.

PROPELLING MACHINERY, TWIN SCREW VESSELS

In the twin screw vessels propelled by reciprocating engines, the boiler plant will be identical with that for the single screw vessels. The engines themselves will be of the triple expansion type with cylinders 14¾ by 25 by 42 inches diameter with a common stroke of 27 inches. The engines will turn outboard when going ahead.

The engines will be built for a piston speed of about 600 feet per minute and each engine will be capable of developing 900 indicated horsepower at 133 revolutions per minute, when working under full boiler pressure with live steam in the receivers, and 700 indicated horsepower at 115 revolutions per minute, with no live steam in the receivers. Engines of different size from the above will be accepted if they are capable of meeting the desired conditions of indicated horsepower and piston speed.

The framing of the main engine consists of cast iron back housings and cast iron or forged steel front columns. The bed plate is of cast iron. The main valves for the high pressure and intermediate cylinders are of the piston type with a slide valve for the low pressure cylinder. The valve gear is of the Stephenson link motion with double bar links.

The operating platform of each engine will be on the inboard side at the engine room floor with reversing gear, throttles and stop valve gears, cylinder drains, receiver valve gears, etc., all collected at one point.

The crank and thrust shafts are 8 inches in diameter, while the line shafting is 7½ inches diameter. The propeller shaft is 8½ inches diameter. The propellers are solid, three-bladed of cast iron.

ENGINE ROOM AUXILIARIES

Two main condensers are provided, each with a condensing surface of 1,300 square feet. There are two main circulating pumps of the centrifugal type with 8-inch suction and discharge, each pump being driven by a vertical engine. The main air pumps are of twin beam type, 7½ by 17½ by 10 inches.

The independent pumps include the following:

Two main and auxiliary feed, 10 by 6 by 12 inches, vertical simplex. One general service, 10 by 6 by 10 inches, horizontal duplex. One fire, bilge and general service, 10 by 6 by 10 inches, horizontal duplex. One sanitary, 6 by 5¾ by 6 inches, horizontal duplex. One fresh water, 4½ by 2¾ by 4 inches, horizontal duplex. One evaporator feed, 4½ by 2¾ by 4 inches, horizontal duplex.

A feed water heater and feed and filter tanks and other auxiliaries are provided, similar to the equipment for the single screw ships.

PROPELLING MACHINERY, SINGLE SCREW GEARED TURBINES

For a single screw, geared turbine, coal-burning ship, the propelling machinery is to be built to conform with and meet the requirements of the American Bureau of Shipping and the rules and inspection prescribed by the United States supervising inspectors of steam vessels.

The turbine is to be of the General Electric, Westinghouse, De Laval, Kerr or other approved make of 1,400 shaft horsepower and connected to the main shaft by double helical gearing. The revolutions of the main shaft are not to exceed 110 per minute. A backing turbine will be incorporated in the same casing with the ahead turbine, and, when supplied with the same amount of steam as used for full load conditions, will develop not less than two-thirds of the full power ahead torque on not more than two-thirds of the full speed revolutions per minute.

With steam at 180 pounds gage pressure at the throttle and 28 inches vacuum in the condenser, and at normal full power revolutions, the steam consumption will not exceed 12.5 pounds per shaft horsepower per hour.

The thrust bearing will be of the Kingsbury type, incorporated in the low speed gear and casing. The propeller is of cast iron, solid, four-bladed.

The engine and fire room auxiliaries are the same as in the single screw ship driven with reciprocating engines with the exception of the main air pump, which will be of the twin-beam type, 12 to 28 inches by 18 inches. There will also be an auxiliary combined air and circulating pump, 10 by 12 by 12 inches, horizontal duplex.

FORM OF CONTRACT

Contracts for the construction of the standard type wooden vessel, it is understood, will be let on a lump-sum basis only. According to the terms of the contract, for an order for twelve ships the Shipping Board agrees to pay a certain sum within thirty days after signing the contract; 5 percent of the contract price of all twelve ships within sixty days after signing the contract; 5 percent of the contract price of all twelve ships within ninety days after signing the contract.

When the keel of each ship is laid there will be paid 20 percent of the price of the ship. When each such ship is completely framed, 30 percent of the price of the ship will be paid. When each such ship is launched, 15 percent of the price of the ship will be paid. When the machinery in each ship is installed, 10 percent of the price of the ship will be paid and the balance on each ship will be paid thirty days after delivery to and acceptance thereof by the owner.

Before final acceptance of the ship, the owner may make at the contractor's expense a dock trial of not exceeding six hours, or a sea trial at some point convenient to the contractor's yard of not exceeding four hours.

Inspectors appointed by the owner will inspect all materials and workmanship entering into the construction of the ships, and these inspectors are authorized to reject all materials and all workmanship which do not comply with the specifications agreed to.

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The owner reserves the right by orders in writing to make such reasonable alterations, improvements, additions or substitutions not materially affecting the general design of the vessel as the owner may deem necessary. Such alterations or changes will be compensated for by the owner.

Corrosion of Condenser Tubes*

It is common knowledge that the committee originally appointed by the Institute of Metals to investigate the corrosion of condenser tubes has been reconstituted, and now includes representatives of the Admiralty and the Board of Trade, as well as members appointed by some other societies and corporations specially interested in this matter. The earlier researches were conducted at Liverpool by Mr. (now Captain) G. D. Bengough, in such intervals as his normal work at the university permitted. On the reconstitution of the committee, however, substantial financial aid was promised from national sources, on condition that the work should be pushed forward under the direction of a "whole-time" investigator, a post which was naturally offered to Captain Bengough. The research is now being conducted under ordinary working conditions at the Corporation Electricity Works, Brighton, while the laboratory investigations are being carried out at the Royal School of Mines under the immediate direction of Captain Bengough. At Brighton a set of eight small condensers, each containing 12 tubes, 3 feet long, are being run in parallel, both with each other and with one of the main condensers at the power station. The cooling water is obtained from the sea, the station being situated on the inlet at Shoreham. The tubes in the several small condensers are in each case of a different material, and, for the purposes of comparison, 16 of the tubes in a main condenser of the power station have been replaced by special tubes of four different alloys.

A special interest attaches to the installation because the power station condensers have been fitted with the Cumberland system of tube protection, which is effected by maintaining an electric current between the tubes and the electrolyte in such a direction as to inhibit corrosion. No tubes or materials are tested at Brighton until preliminary tests in the laboratory have given promise of results justifying the additional expense. The work so far accomplished has shown that corrosion may be started by defects in the tube arising in the course of manufacture. In the case of brass tubes the presence of a "spill" inevitably leads to erosion. This "spill" originates in a blowhole against the sand core of the casting from which the tube is made. In the process of drawing this hole is deformed into a long groove, which is covered with a tongue or sliver of metal. Air collects in the space underneath this "spill," and whenever air collects on a brass tube immersed in sea water corrosion appears to be inevitable. Each tube is very carefully examined for internal flaws before being tested at Brighton, and the position of each is carefully recorded. Not all surface defects, even in brass tubes, appear to give trouble. An open groove, free from the long covering "spill," appears to matter little. The "swarf" holes are an example of this. These are produced by a neglect to completely clear the tube blank from every bit of swarf after boring and before drawing. The pits produced by these particles of swarf appear to matter little.

A point now being investigated is whether the presence of oxide in the tube is deleterious. To this end a number of oxide-free brasses have been prepared from cathode copper and Brunner-Mond zinc, melted in an atmosphere of hydrogen. The molten metal was not cast, but allowed to set in the crucible, which was cooled from below, so that the gases occluded on solidifying should not be entrapped. The whole of this operation was conducted in an atmosphere of hydrogen, and the tubes have been prepared from this oxide-free metal by the Broughton Copper Company. These tubes are now under test, but as yet it is uncertain whether they will show any superiority.

Among the tubes being tested are those containing 2 percent of lead, introduced by the Muntz Metal Company some few years ago. Since the lead does not form a solid solution with the rest of the alloy, but separates out in small spicules, it might have been anticipated that the presence of this free metal would give rise to local electrolytic effects and consequent corrosion. It appears, however, that this does not occur; the lead forms an adherent basic salt, which spreads over the surface and appears to protect it from further action. Another metal under test is an alloy of 10 percent of nickel with 90 percent of copper. So far this has proved quite immune to attacks in the laboratory, although the tubes furnished have had such rough interiors that when placed in a sea-water bath they immediately cover themselves with air bubbles. When similar bubbles collect on brass a white oxychloride of zinc is deposited, which acts as a catalytic agent, taking up chlorine from the sea water and passing it on to the zinc, with the result that the metal is dezincified. The resistance of the 10 percent nickel alloy is the more notable in that failures are reported to have occurred with tubes made from a 20 percent nickel alloy and from a 2 percent nickel alloy. Another interesting alloy under observation is one of copper with 7.8 percent aluminium. Preliminary tests with this have proved promising, and it is hoped to get still better results with oxide-free metal. The specimens so far tested have not been free from oxide, and have been found liable to a very curious attack consisting of small pinholes, which deepen rapidly. Elsewhere there appears to be no corrosion at all.

An American report having stated that the resistance to corrosion is improved by annealing the metal at a temperature just high enough (about 400 degrees C.) to secure recrystallization, the point is being thoroughly investigated, the annealing being effected in an electric furnace which can maintain indefinitely four tubes, each 4 feet long, at the desired temperature within a range of some 4 degrees C. Other tubes are being annealed at a temperature of 600 degrees C. before the test. This temperature destroys the effect of cold-working, which is commonly supposed to favor corrosion.

In the experimental condensers at Brighton the temperature on the steam side of the tubes differs much from point to point. The middle of the tubes, immediately under the steam inlet, is kept clear of air by the inrush of the steam, and the tube is consequently hot here. At the end of the condenser, the steam being more stagnant, air collects round the tubes, materially lowering the temperature. Again, the tubes at the bottom are colder than those at the top. It has been observed that the local temperature of the tube appears to have a marked effect both on its liability to corrosion and on the kind of corrosion set up.

The investigation is undoubtedly one not merely of national but of international importance, since the cost of replacing condenser tubes aggregates annually to an extremely large figure. It is to be hoped that the research will be pushed to a successful conclusion as rapidly as the conditions permit. Since, however, accelerated tests are considered unreliable, the investigation must necessarily require some years for its completion, but interim reports of high value will undoubtedly be issued from time to time.

* From *Engineering*.

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Reinforced Concrete for Shipbuilding

Discussion of Application of Reinforced Concrete to Ship Construction—Design for Reinforced Concrete Barge and Freight Steamer

BY ALLEN HOAR, C. E.

THE shipping industry is to-day facing one of the most serious problems with which it has ever been confronted. The daily destruction of tonnage, figuring into several thousands, forces us to meet an overwhelming shortage in cargo bottoms. The immediate effect of this upon commerce and industry—the merchant, the manufacturer, the producer, the consumer—is at once apparent. It is bound to upset the whole economic balance of the entire world. At the cessation of the present hostilities in Europe the greatest activity in shipbuilding ever known must be looked forward to. Ships lost must be replaced and the number increased to take care of the enormous amount of shipping incidental and necessary to the period of reconstruction throughout Europe.

Drain on Steel and Lumber Resources

But how is this to be accomplished—what about the present status of the steel and lumber industries? At the present time, with the shipbuilding activity of this country just awakening, the cost of these materials is almost prohibitive. Furthermore, the vast drain created by this activity on the developed resources of the country is sorely affecting other industries, the chief consumers of steel and wood under normal conditions, and ultimately the public, who must pay for the increased high cost of goods.

The only practicable solution of this problem, then, seems to be in finding some other suitable material for this purpose—one which is a relatively cheap commodity, the raw supply of which is obtained in great abundance, widely distributed throughout the entire country and nearby our sea coasts. The only building material which has these qualifications, together with the necessary physical requirements, is reinforced concrete. This material presents itself as the logical one to replace steel and wood in the construction of ships, not merely as a substitute for steel or wood, but as a material superior to either of these from the standpoint of general adaptability, first cost and cost of maintenance.

Concrete Ships No Novelty

Concrete as a material for ship construction is not new, although today its general use for this purpose is looked upon with the same degree of skepticism that steel was but a very few years ago. The employment of reinforced concrete in the construction of vessels may be truthfully said to date back to the time of the early Egyptians. In Egypt boats were built of clay and reed, and used on the Nile several hundred years ago. These boats were built of a natural clay or cement plastered over a framework of reeds for reinforcement. The principles of construction used were practically the same as those used on many types of vessels that have lately been built, except that now steel is used instead of reed and Portland cement concrete instead of natural cement.

Since this time many experiments have been made and much progress accomplished in the use of reinforced concrete for the construction of floating bodies. In the last few years particularly, there have been many and various types of reinforced concrete vessels constructed. These have included floating caissons for foundation work, pontoons for various purposes, floating drydocks, pleasure craft, lighters, cargo vessels—both towed and self-propelled vessels—and car ferries. Although up to the present time no large ocean-going steamships have been constructed of this material, freight lighters having a full-load displacement of three thousand tons or more have been built, and this is but indicative of what can be done and a substantial evidence of the practicability of reinforced concrete for use in shipbuilding.

Concrete materials are found ready to hand in practically all markets. Cement is manufactured, or can be manufactured, nearby almost every available location suitable for shipbuilding. The raw materials for cement are widely distributed over the entire country and the supply is almost without limit. The proximity of cement mills to the sea coast eliminates the factor of disproportionate freight rates. Reinforcing steel can be rolled by small local mills, and, therefore, the user of it is not made subservient to the convenience of the large steel corporation in the manner in which the builder is who must use large plate and heavy rolled structural shapes. Sand and gravel can oftentimes be found at the site of construction. In fact, all the materials for a concrete ship can be found within the radius of a very few miles, and the vessel built practically at the launching point.

Physical Properties of Reinforced Concrete

Next for consideration are the physical properties of reinforced concrete. The various classes of structures and uses in which reinforced concrete has been employed, and its behavior under stress, are too well known to need any lengthy discussion here. Theoretical studies and practical experiments have now produced rational and positive methods for computing the strength of reinforced concrete so that absolute dependence can be placed upon it. Reinforced concrete has safely withstood forces of sudden impact caused by failure of or accident to some adjacent member or mechanism. It has proved itself superior to any other building material in resisting severe earthquake shocks and like disturbances in many parts of the world. It is a material in which its internal resisting qualities can be so utilized and distributed to the most advantage—the steel where it is most efficient in taking up the tension, and the concrete where it will best react against compression. To properly and economically take care of the excessive strains to be encountered in ship work requires just such a material as this.

The plastic nature of concrete is ideally suited to the formation of shapes and curvatures so difficult and costly to make with either steel or wood. Reinforced concrete instantly adapts itself to the construction of any desired shape—it is essentially a material to be molded, and a ship is essentially a structure to be molded. The monolithic character of reinforced concrete construction affords at the same time, the greatest amount of strength and rigidity with the maximum amount of elasticity.

The ability of reinforced concrete to withstand the extreme stresses to which a ship rolling in a heavy sea is subjected, supported first almost entirely on two waves, one at the bow and the other at the stern, and then riding

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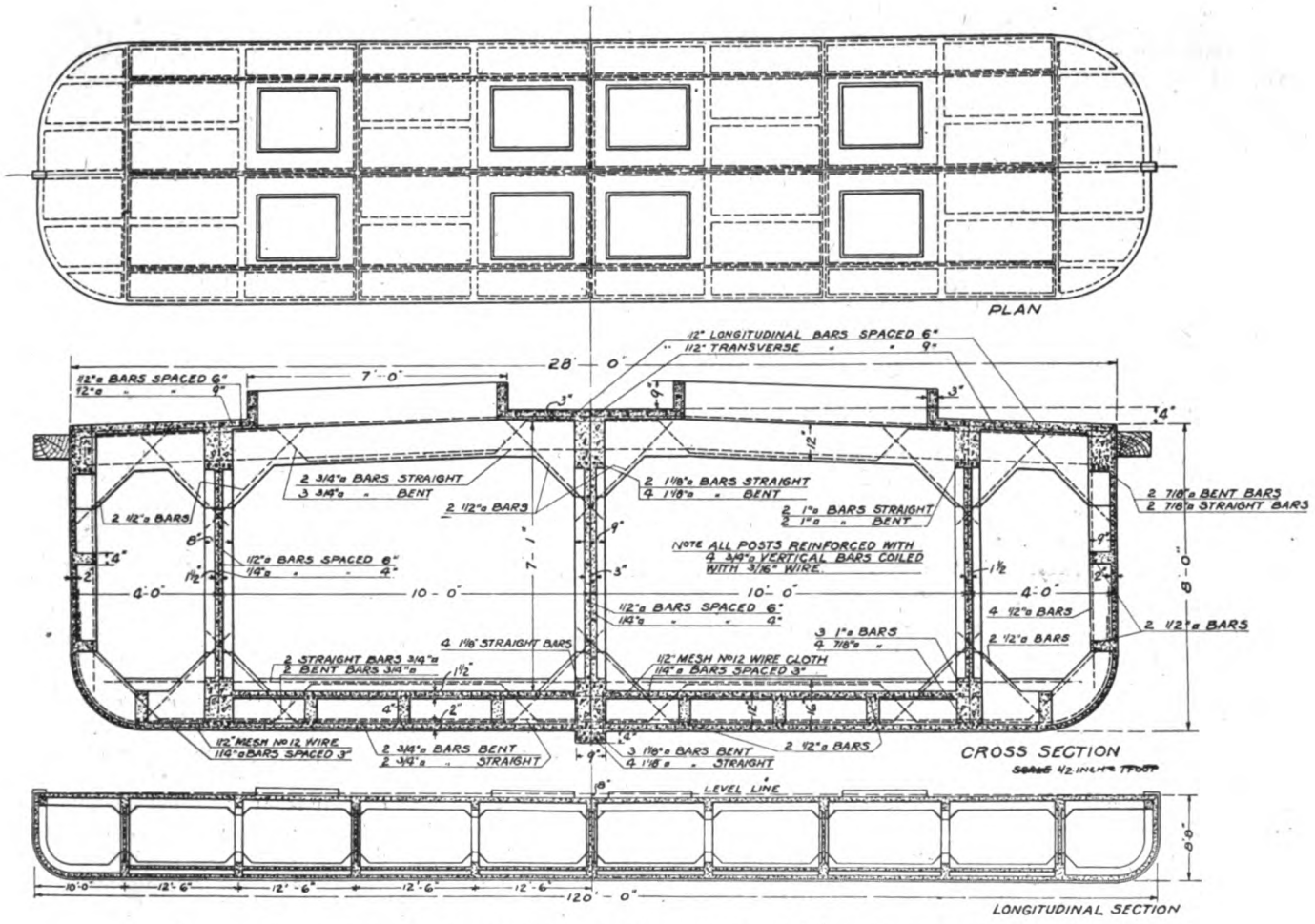

Fig. 1.—Design for Reinforced Concrete Barge, 120 Feet by 28 Feet by 8 Feet Depth

upon one wave under the center, seems to be the point about which there is the most skepticism. It may be stated, however, that with the exercise of ordinary skill in design and construction there should be no more liability of failure with reinforced concrete than with any other structural materials. It cannot be too strongly emphasized, however, that a thorough knowledge of the theory of design is essential as well as experience and vigilant inspection during construction.

That a ship of reinforced concrete can be built safely to withstand these stresses and yet compare favorably with a steel ship, as far as weight is concerned, may be clearly realized after giving due consideration to the characteristics of these two forms of construction. The resistance of a steel ship to longitudinal bending is limited to the strength and efficiency of its riveted joints and connections, which are extremely susceptible to "working" under the alternating loads imposed, and therefore the true strength of the ship is in the shear of its rivets and rivet holes, which is but a small percentage of the tensile strength of the steel taken through any section of the ship.

Shearing Stresses in Concrete Ship

In a reinforced concrete ship all the shearing stresses occurring in the structure may be taken up by direct tension in the steel, thus utilizing the steel so as to benefit by its strongest properties. There are no rivets or the like to work loose and thus accentuate the deflections and the resulting stresses. The safety of a reinforced concrete structure increases with age, the concrete growing harder and the bond with the steel becoming stronger. The coefficient of bond between the concrete and steel has been determined within safe limits, and with proper design there need be no danger of the steel pulling out.

Recent scientific experiments, as well as actual practice, have proved reinforced concrete to be safe under repeated and vibrating loads. It absorbs these recurring shocks as no other material does, and would materially lessen the machinery vibrations experienced in steel ships.

Distinctive Advantages of Reinforced Concrete Ship Construction

Chief among the distinctive advantages of reinforced concrete is its great length of life as compared with either steel or wood. While these materials tend to decay or corrode in a very short time when subjected to the action of sea water and its animal life, concrete, if well proportioned, of first-class materials and properly applied, is absolutely impervious to the action of sea water and proof against boring animal life. If a first-class cement is used with a clean, coarse, sharp sand and a well proportioned aggregate, in the proportion of at least 1 : 1½ : 3, a good, strong, dense concrete of indefinite life will result.

Concrete expands and contracts with changes of temperature. Its coefficient of expansion, that is, its expansion per unit length per degree rise of temperature, is almost identical with that of steel, and on this account there is no tendency of the two materials to pull apart, but they act together under all conditions. In such a structure as a ship, free to expand or contract unrestrainedly, there need be no special provision made to care for this, as is necessary in a large bridge, building or dam.

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Reinforced concrete ranks high with the best fireproof materials, and on this account is a material much to be desired for ship construction. The fire resistance of concrete grows with age, as does its strength, as the water held in its pores is gradually taken up chemically and is evaporated.

A reinforced concrete ship is monolithic throughout, just as if it had been carved out of a solid rock. The frames, beams, girders and stringers are continuous from side to side and from stem to stern of the ship, while even the hull and decks form integral parts of these members, as do the columns, the entire structure being tied together by the reinforcing steel.

All this accounts for the extraordinary stiffness and solidity of a reinforced concrete structure, and differentiates it from timber or steel construction where either positive joints occur over the columns, as in timber construction or where all the connections are riveted joints, as in steel construction.

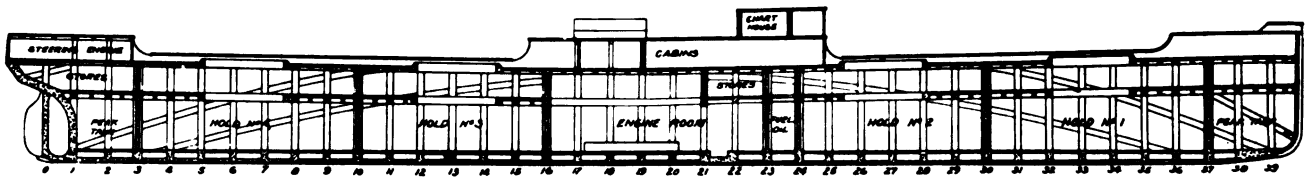

Fig. 2.—Longitudinal Section—Reinforced Concrete Freighter, 330 Feet by 43 Feet by 26 Feet; Displacement, loaded, 7,000 Tons; Cargo Capacity, 2,500 Tons; Indicated Horsepower, 2,000; Speed, 12 Knots

This solidity and entire lack of joints especially adapts reinforced concrete for use under varying and alternate loading and to heavy and high-speed machinery. The vibrations are deadened and taken up in a way which is impossible in a steel structure.

Steel rods are set in the concrete to provide for tension in such amount and where needed for any special loading for which it may be designed. Consequently spans can be constructed of any reasonable length and column spacing may be adopted to meet the requirements of the situation.

The speed with which a reinforced concrete ship can be constructed is much quicker than with any other material, because, in the first place, there need be no waiting for materials. Sand and stone are always available; large quantities of cement are always kept in storage by the mills, and steel rods are kept in stock by all dealers, so that a ship can be commenced as soon as the plans are completed and no delays need be incurred in ordering special shapes and awaiting their shipment from the mills.

Cost of Ship Construction

As a fundamental principle of economics the cost of a ship must be such that the outlay for interest on the first cost, operation and maintenance shall be as small as possible, consistent with the requirements of good design and the purpose for which intended. A wooden ship is the cheapest in first cost, and therefore in interest charges, but has a short life and is most expensive in repairs and in insurance. However, with the present high cost of good timber, it will frequently be found that the cost of reinforced concrete is cheaper than timber, and with its much longer life and minimum of upkeep charges the economy of this class of construction is very apparent.

The exact cost of a ship in any case is governed by the local conditions, and in reinforced concrete construction the same ruling applies. The design, the loading for which it must be adapted, the price of cement, the cost of obtaining suitable sand and gravel, the price of form lumber, the construction methods adopted for doing the work, the price of reinforcing steel, the wages for laborers, carpenters, and so forth, all are factors entering into the estimate. However, in reinforced concrete work by far the greater portion of the work is done by common labor, and therefore the high rates of skilled labor will affect the cost of a ship built of this material less than it will the cost of any other structural material.

The economic aspects of the use of reinforced concrete for ship construction are demonstrated to some extent by the following examples worked out by the author, and it is believed these could be much improved upon.

Fig. 1 shows the general plan of one of a fleet of concrete barges designed for the transportation of crude salt about San Francisco Bay and river points. The length is 120 feet overall with a breadth of 28 feet and a depth of 8 feet. The hull is divided into watertight compartments by longitudinal and transverse bulkheads, and is provided with heavy projecting wooden fenders to guard against collision. The deck is 3 inches thick and fitted with large trunk hatches to each compartment, providing for easy loading and unloading. Light wooden hatch covers or canvas awnings will be fitted over the hatches. The weight of the hull complete will be about 258 tons and will draw about 2 feet 7 inches of water in the light condition.

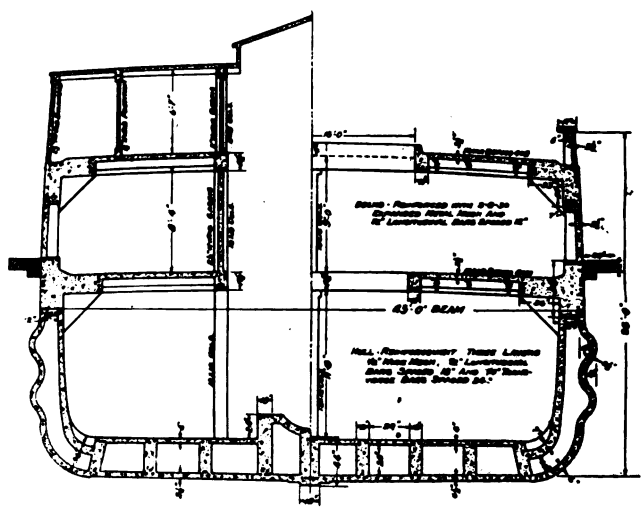

Fig. 3.—Transverse Section, Reinforced Concrete Freighter

The cargo capacity will be about 400 tons on a draft of 6 feet 6 inches.

The principal advantages of this design over wood or steel are low first cost and low cost of maintenance. In Table I is shown the estimated cost for the concrete barge in comparison with barges of the same size built of creosoted pine and of steel. These figures are based on the present price of materials and the cost of labor.

The repair charge of the wooden barge is the average cost of repairs on 31 different wooden barges built of treated lumber and the repairs for the concrete and the steel barges are estimated. The charge for interest on repairs is based on the average yearly repair charge and

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the interest computed over half the number of years of the estimated life of the barge.

TABLE I

	Reinforced Concrete	Wood	Steel
Estimated life, years	35	15	25
Displacement (light), tons	259	135	151
Pounds per cubic foot capacity	19.25	10	11.2
Cost per cubic foot	.318	.304	.687
First cost	$8,547	$8,171	$18,466
Total cost of repairs	855	2,432	1,847
Interest on first cost at 5 per cent	15,000	6,128	23,082
Interest on repair cost at 5 per cent	7,500	912	11,541
Total cost	$31,901	$17,643	$54,935
Total annual cost	$911.5	$1,176.2	$2,197.4

Fig. 2 shows a design for a small ocean-going freight vessel. The principal dimensions are: Length between perpendiculars, 312 feet; beam molded, 43 feet; depth molded, 26 feet, and a total displacement of 7,000 tons.

The proposed method of construction is as follows:

Hull, material, plaster concrete of 1 : 1 : 2 mix, using ¼-inch stone. Reinforcement, wire mesh and ½-inch longitudinal bars. Mesh to be secured by wiring to reinforcement of frames and to longitudinal bars on outside. Concrete to be plastered to the inside of the mesh and then brought to the required thickness by using the cement gun on the outside, thoroughly imbedding the mesh, rods, and a second lighter mesh close to the outside surface. The outer surface will be brought to a hard troweled finish.

Frames, posts, stringers, beams, keelsons and girders to be of 1 : 2 : 4 stone concrete cast monolithic in place, reinforcement, square and round bars. Forms to be erected and the concrete placed by the pneumatic system of mixing and placing.

Inner bottoms and bulkheads to be 1 : 2 : 4 stone concrete precast in slabs, transported to position and grouted in place. Proper provision will be made in all slab work for making efficient connections of all reinforcement and joints to develop the full strength of the steel.

Decks will be monolithic of 1 : 2 : 4 stone concrete cast in place by the pneumatic method, reinforced with ½-inch square bars both ways.

All deck houses and superstructure will be of plaster concrete of 1 : 3 mix applied to Hy-rib metal lath by the cement gun.

Ferro-Concrete Vessels*

The fact that the building of ferro-concrete vessels has been commenced on a fairly large scale, first in Norway and now also in Sweden and Denmark, has naturally centered a considerable amount of technical interest on the question. In Sweden it has been discussed at some length, both in the technical press and at meetings of engineers.

One of the points which has been insisted upon by opponents of the material is the inability of concrete to resist the influence of salt water, however excellent it admittedly is in fresh water. The danger arises from the lime liberated, in the process of hardening, entering into combination with the sulphuric acid and magnesium salts of the salt water. At the instance of the German Concrete Union, the Prussian Department for Public Works, and other authorities, some extensive tests were commenced at the island of Sylt in the North Sea, and these tests have not yet been terminated. Concrete blocks were laid on the shore, fully exposed to the chemical and mechanical influences of the sea. The blocks were molded in two mixtures, A and C, the cement of the former containing about 65 percent of lime, and that of the latter only 61 percent to 62 percent. But the latter was richer in alumina and iron, 10 percent to 12 percent, against 6 percent to 8 percent in A. The concrete blocks were so placed on the shore that at high water they were entirely submerged, and at low water only partly so. After as little as two to three years the C blocks, even such as were molded in mixtures 1 : 2, showed fine cracks, and after three to four years the surfaces had all suffered much. The A blocks, in a rich mixture, stood the test better, and in mixtures 1 : 2 they were unaffected after four to five years; with poorer mixtures, 1 : 4, the edges had suffered, and with still poorer mixtures were much affected after as little as one to two years.

Recent experiments in the United States have shown that an addition of 5 percent of finely ground clay to a mixture 1 : 3 : 6 rendered it more resistant, also more so than the same mixture with 10 percent of lime added. On the whole, however, all the test blocks suffered more or less.

In spite of all this there are numerous cases in which concrete has withstood the influence of salt, even very salt, water quite satisfactorily; it is in almost universal use for harbor works, etc. The current explanation of the unfavorable effect of salt water upon concrete is that the sulphate of magnesium in the water combines with the lime in the concrete, forming sulphate of calcium, which is of larger volume and therefore has a bursting effect upon the concrete. There are, however, many other kinds of cement, and especially cement of the so-called puzzolane type, not only free from a surplus of lime, but with a surplus of silicic acid, and thus able to bind free lime. The addition of such kinds of cement and other substances containing silicic acid has therefore for a series of years been used as a protection against the undesirable effects of salt water.

In the reports for 1915 from the Gross Lichterfelde West Material Testing Institution some exhaustive laboratory experiments as to the influence of different solutions upon concrete mixtures of 1 : 3 and 1 : 6 were dealt with.

The 1 : 6 concrete was all more or less affected, but all the 1 : 3 concrete tests showed that no harm had been done to the concrete, except in one case, in which the block had been kept in a closed exsiccator during the hardening, and had been submerged in sulphate of calcium solution. The use of too much fine sand in the mixture is undoubtedly injurious. This was shown very plainly in *Le Cement* last year. The unsatisfactory result of the American tests already referred to may to a great extent be attributed to the very fine sand which was used for the mixtures.

It is clearly evident that concrete can only be affected by sea water to the extent that water penetrates it. If the concrete is sufficiently dense, nothing but the surface is exposed to any risk, and the making of dense concrete is no longer a novelty.

Protective measures in the construction of concrete vessels may be summed up as follows: (1) The use of rich concrete; (2) the use of cement with but little free lime, gypsum and alumina; (3) the addition of puzzolane to fix the free lime; (4) the use of coarse sand; (5) the use of dense concrete; (6) surface treatment. Should the cement boat-building industry develop there should not be much trouble in guarding against decay if full use be made of our present knowledge.

In conclusion the advocates of concrete as shipbuilding material urge that concrete in any case is more resistant than steel. The fact remains that reinforced concrete vessels are in existence and are being built, although it is premature at present to express any definite opinion as to their durability and strength.

* From *Engineering*.

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J. F. DUTHIE & COMPANY, SHIPYARD

Seattle's Latest Addition to the Shipbuilding Industry

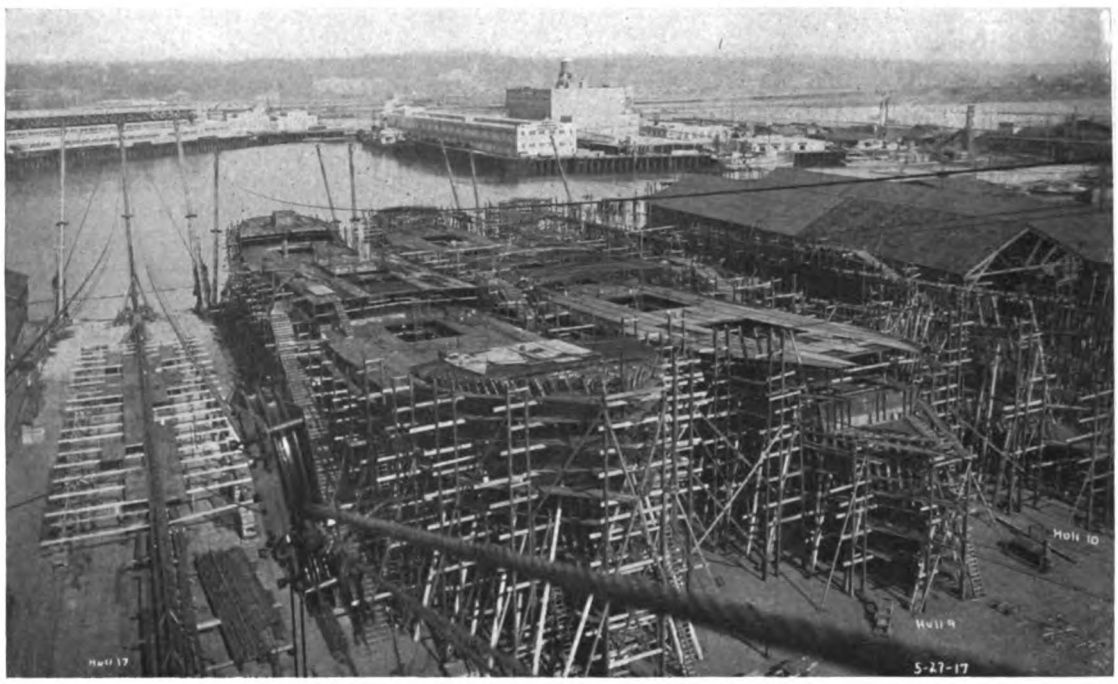

Fig. 1.—General View of Building Slips

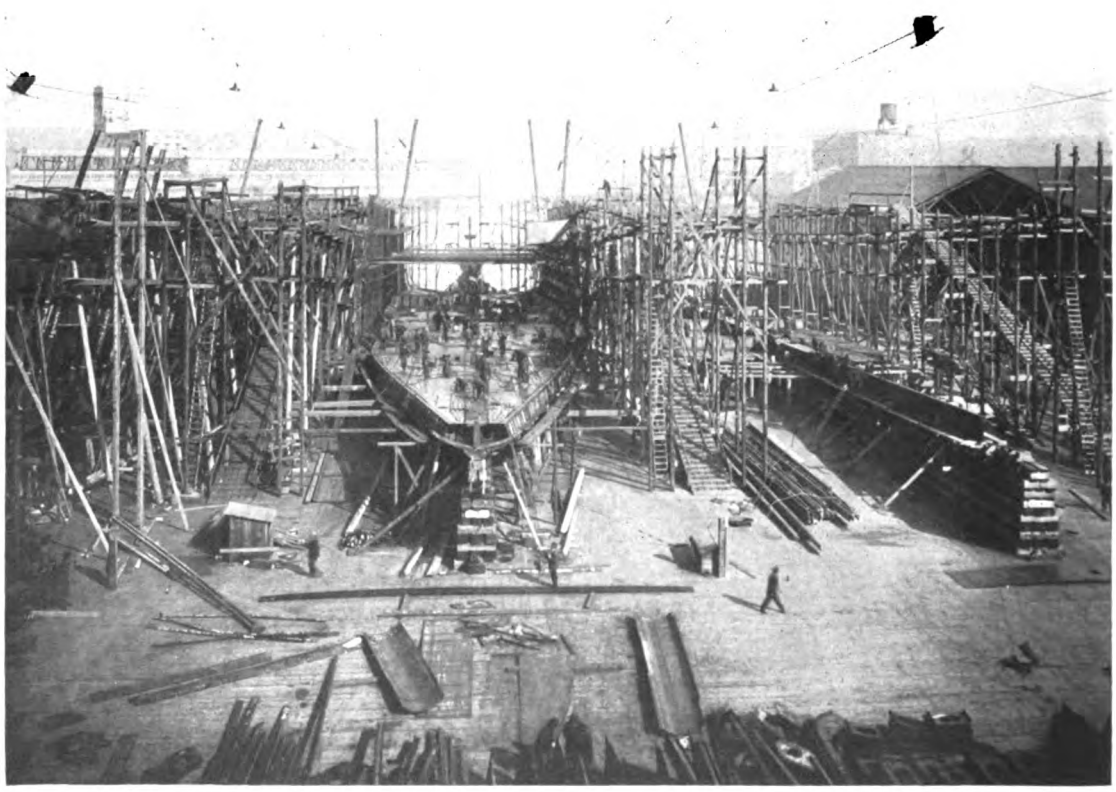

Fig. 2.—Head of Building Ways, Showing Aerial Tramway System and Storage Space for Fabricated Sections and Material

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Fig. 3.—Panoramic View of the Duthie Shipyard

J. F. Duthie & Company Shipyard

**Another Addition to Seattle's Shipbuilding Industry—
Plant Covers Twelve Acres, with Four Building Slips**

SITUATED on Seattle's East Waterway and covering approximately twelve acres of ground is the new steel shipbuilding plant of J. F. Duthie & Company, well-known ship and engine builders of the Northwest. This plant, while entirely new and separate from the former J. F. Duthie establishment, emanated from the efforts put forth by Mr. Duthie, who has many years of successful ship and marine engine building to his credit.

The plant is located on a portion of what was once the Seattle tidelands, but which property was made extremely valuable for industrial purposes by filling in with sand and earth taken by suction from the adjacent waterway, thereby making a deep and navigable channel alongside.

Layout of Buildings

Extreme care and forethought were taken in the general layout of this plant, which is up-to-date in every particular, about one-third of the complete plant area being under cover. The many crane and locomotive tracks advantageously arranged permit the handling of the material to be used for construction with the least possible effort.

The material, when ready for setting up on the respective ships, is handled by aerial tramways, a system now extensively used in the Northwest. The conveyor winches are placed on substantially built platforms high in the air and a considerable distance forward of the bows of the ships, thus enabling the winch operators who are also stationed on these platforms to have an unobstructed view of the ships which they are serving and giving ample room between the ships and the forward uprights for the handling and stowing of material and built-up sections until ready for installation on the various ships. The after uprights of this aerial system, unlike any of the other yards on Puget Sound, are placed at a very acute angle to the ground and lean out toward the water. In this way, when large loads are carried, the tension in the stay is made less than if the upright were placed perpendicular; a great portion of the stress being taken up by the thrust created in the upright.

Shops and Equipment

The plate and angle shop, which is about 900 feet long, is equipped with all the modern devices for handling and fabricating the material. It is spanned by an overhead traveling crane which runs the length of the shop, distributing material to the individual wall or jib cranes, fitted with pneumatic travelers and hoists, which in turn serve their respective punches, shears, beam benders, rolls, planers, etc.

The blacksmith shop and machine shop are located parallel to the plate and angle shop, but on the opposite side of the yard, the intermediate space containing the four building slips which are now all occupied. These two shops are built in one, so that castings and blacksmith work in general, requiring machining, may be conveyed directly from one building to the other by an overhead crane similar to the one in the plate and angle shop and connecting both buildings. These shops are also fitted with the most up-to-date equipment available. In the wings of the machine shop are located shops for copper

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J. F. DUTHIE & COMPANY SHIPYARD

Seattle's Latest Addition to the Shipbuilding Industry

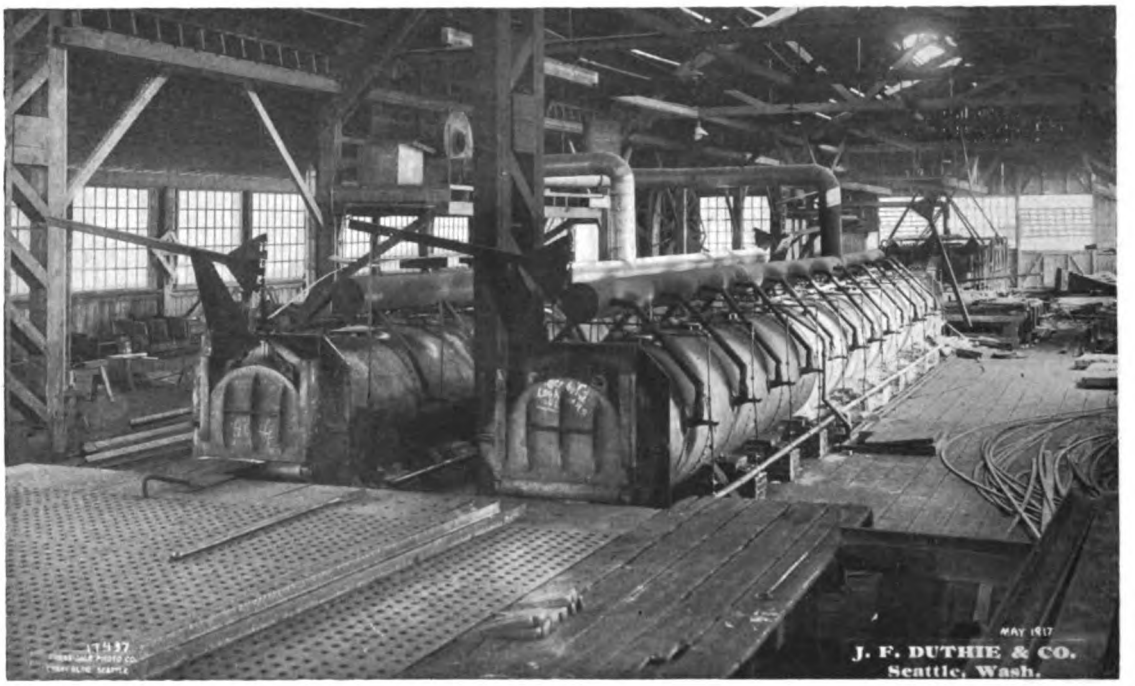

Fig. 4.—Plate and Angle Furnaces and Bending Slab

Fig. 5.—Interior of Mold Loft

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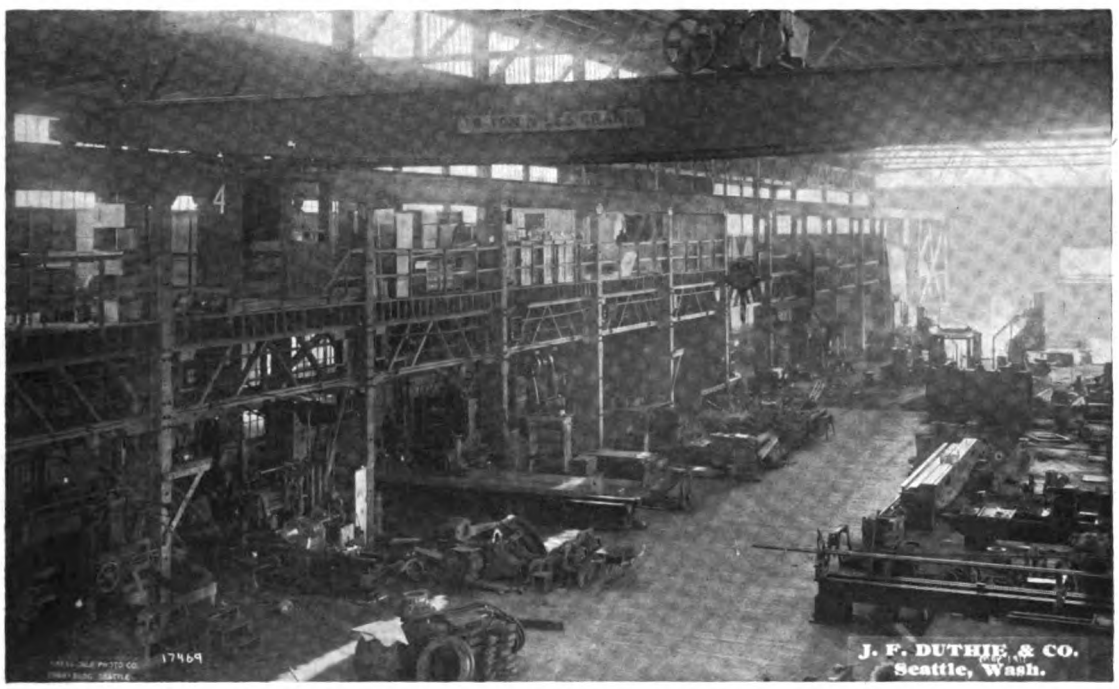

Fig. 6.—Section of Machine Shop

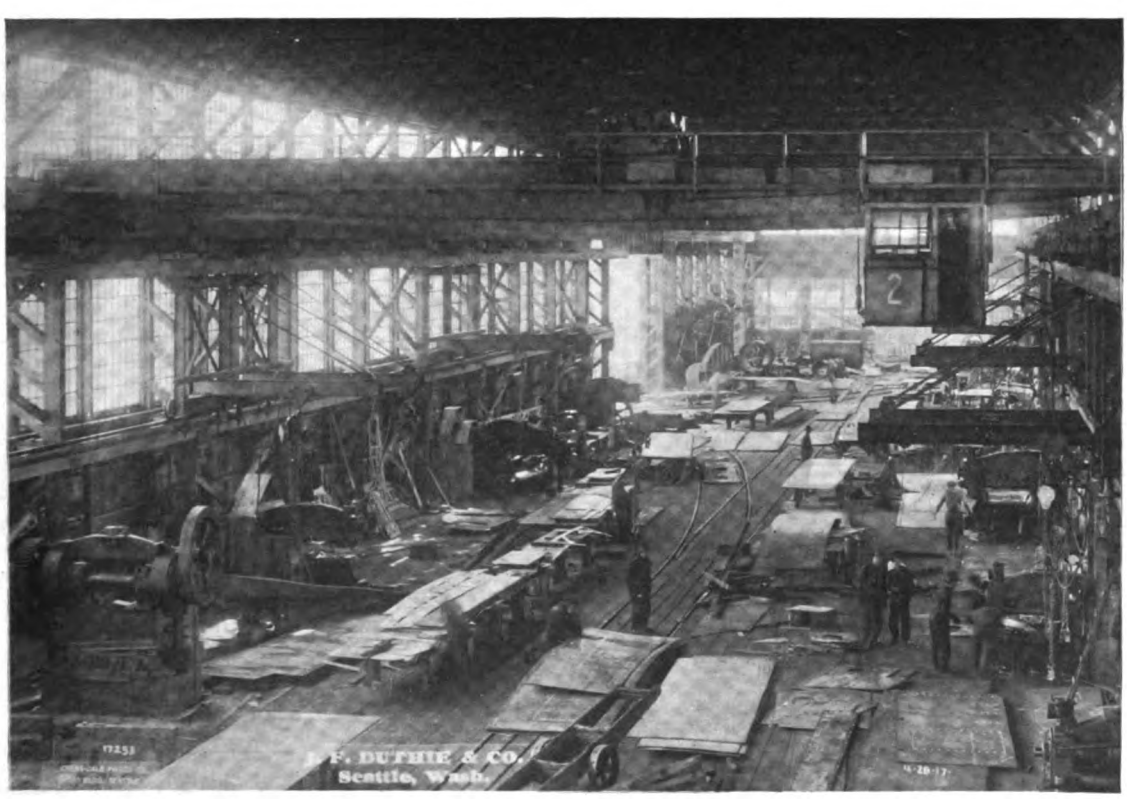

Fig. 7.—Plate and Angle Shop

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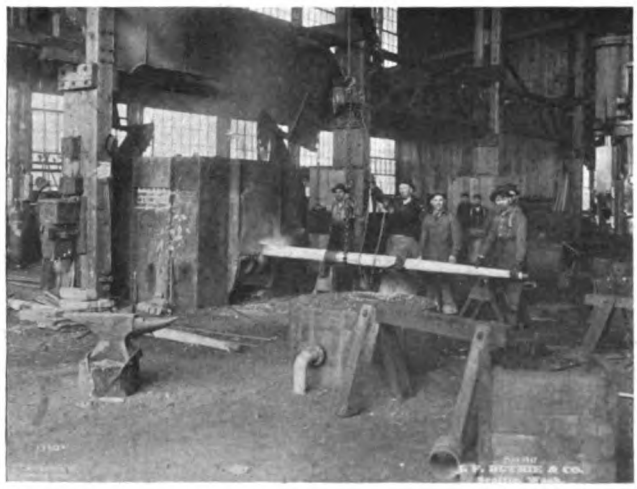

Fig. 8.—Blacksmith Shop

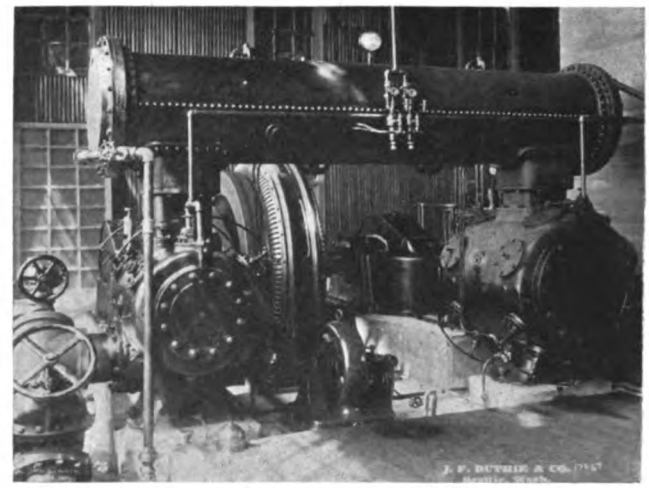

Fig. 10.—Part of Power Plant

and sheet metal working, pipe fitting, storage rooms, etc.

Adjacent to the plate and angle shop and at right angles to it are the furnaces. These are three in number, two being used for angles and one for plates; fired by fuel oil and steam and constructed of steel shells lined with fire brick.

The carpenter, pattern making and joiner shops are also located in one building, space having been given to a certain portion for the storage and natural drying of lumber. These shops are as fully equipped as a wood-working mill, and care has been taken in furnishing a generous supply of light.

In this latter respect the mold loft, too, excels those of many of the other shipyards. It is located on ground level and the sides are paneled in glass, permitting light to come in from all directions. The floor is painted gray instead of the heretofore and much used black, making a much easier color to work by. Storage space has been maintained for the templates, for as the ships being built are all of the same type, these templates can be used over and over again.

Storage Yard

Alongside of the plate and angle shop is the storage space for shapes and plates. All the material in this space is handled by two derricks having booms capable of covering an area of about 160 feet in diameter each, the derrick booms having an out-reach of approximately 80 feet. This storage space is directly connected with the railroad tracks of the various trans-continental railroads.

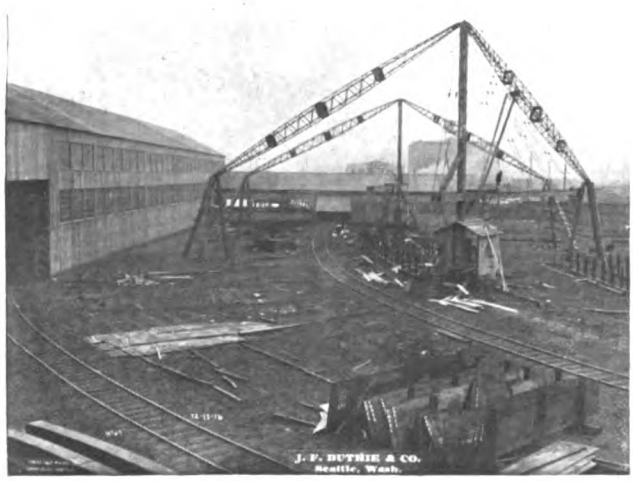

Fig. 9.—Storage Yard, Showing Erection of 80-Foot Booms for Handling Material

All the buildings are of heavy mill construction and are made up of members sufficiently great to withstand the shocks usually caused by loaded cranes. Due to the immense amount of timber used, efficient fire protection methods were immediately installed.

Building Slips

Between the plate and angle shop and the machine and blacksmith shops are the building ways, four in number. These lead out into East Waterway, where there is a good depth of water and an open area sufficiently large to launch with ease any of the modern type cargo vessels now building.

Hospital and Restaurant

The hospital, with a nurse always in attendance, is also located on the grounds. This building, while not large, is fully equipped for the purpose intended and a physician is on duty during most of the day.

For the convenience of the employees a restaurant is maintained nearby, as the distance to the main section of Seattle is too great to be reached within the prescribed noon hour.

The plant is working in three shifts and has at present contracts for ten ships, all of 8,800 tons deadweight.

Correction

In the article on "Standardized Geared Turbines for Cargo and Passenger Steamships," published on page 255 of our June issue, several numerical errors inadvertently occurred. In the third paragraph of the article it is stated that the 1,500 horsepower unit "occupies a space of 21 feet long by 9 feet wide by 8 feet 8 inches high; that is, 164 cubic feet, or equivalent to about 9 horsepower per cubic foot." These figures should, of course, read "1,640 cubic feet" and "0.9 horsepower." Similarly, the space occupied by the 2,500 horsepower unit is approximately 1,800 cubic feet or 1.4 horsepower per cubic foot.

CHANGE OF ADDRESS.—Offices of the National Shipbuilding Company, New York, which were formerly in the Grand Central Terminal, have been changed to 120 Broadway.

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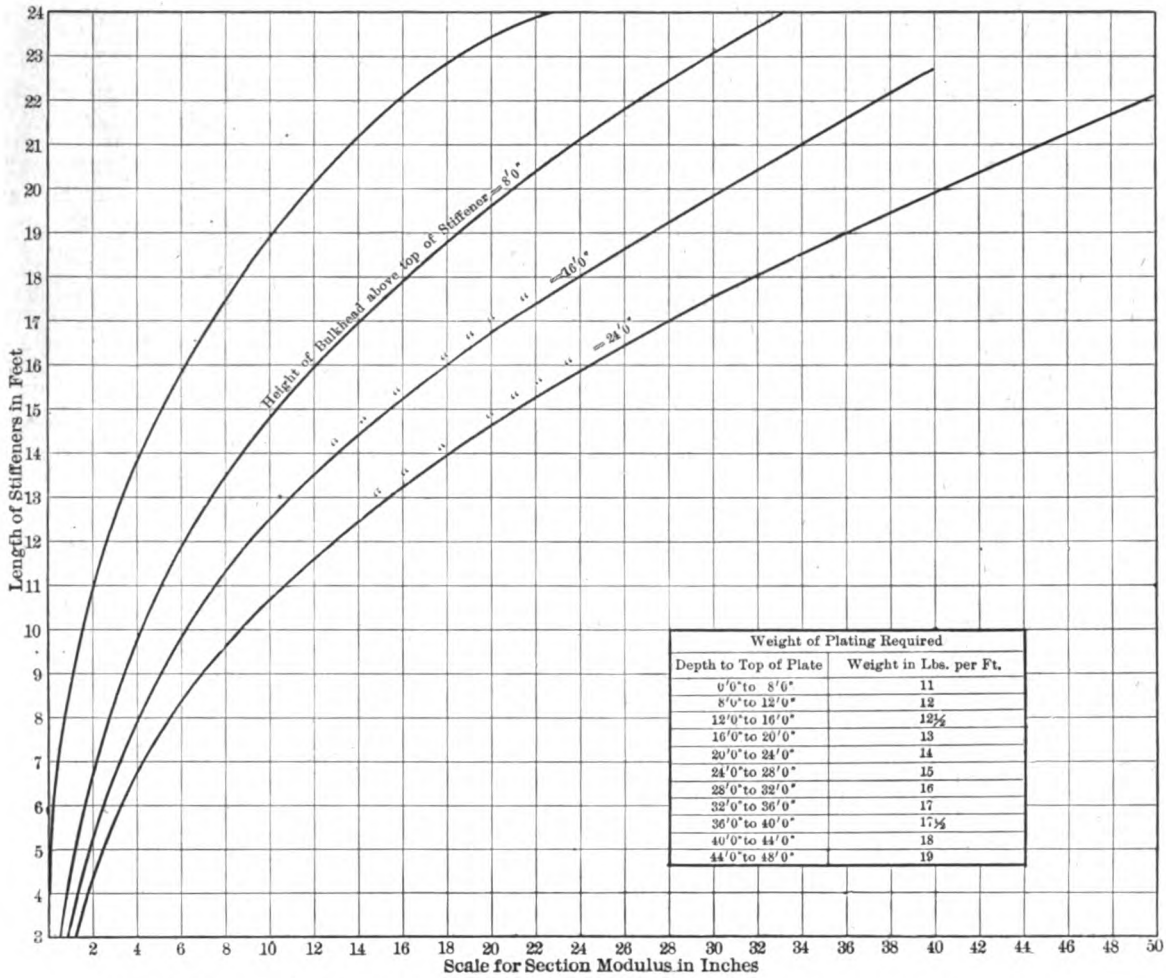
Length of Stiffeners in Feet
Scale for Section Modulus in Inches
Height of Bulkhead above top of Stiffener = 8'0"
" " " = 16'0"
" " " = 24'0"
Weight of Plating Required
Depth to Top of Plate | Weight in Lbs. per Ft.
0'0" to 8'0" | 11
8'0" to 12'0" | 12
12'0" to 16'0" | 12½
16'0" to 20'0" | 13
20'0" to 24'0" | 14
24'0" to 28'0" | 15
28'0" to 32'0" | 16
32'0" to 36'0" | 17
36'0" to 40'0" | 17½
40'0" to 44'0" | 18
44'0" to 48'0" | 19

Fig. 1.—Section Modulus of Vertical Bulkhead Stiffeners as Required by Lloyd's Rules, Spacing 30 Inches Centerline to Centerline

Data for Bulkhead Construction

Curves Giving Section Modulus of Bulkhead Stiffeners Required by Lloyd's Rules from Length of Stiffener

BY F. K. RUPRECHT

LLOYD'S rules for the construction of ships are widely used throughout the world and are modern in every way. The tables for the scantlings of bulkheads embody all the latest available information on the subject and have been kept up with the recommendations of the Bulkhead Committee.

The tables given for the size of vertical stiffeners on watertight bulkheads are all Standard British Sections. Only a few of these sections are available in this country and even when obtainable carry an extra charge and are rolled only by special arrangement with the mill. It is troublesome to convert these sections into sections obtainable in this country because comparatively few complete tables of Section Modulus of Standard British Sections are to be had. With this fact in mind the following curves shown in Figs. 1, 2 and 3 have been plotted, giving the required section modulus as called for by Lloyd's rules for watertight bulkheads directly from the length of the stiffener. Having the Section Modulus it is a very simple matter to choose a section from the steel mills' shape books, which will fill the requirements to hand.

At the outset of this problem it was found that to cover every possible case a great number of curves would be needed. Owing to this an attempt has been made to simplify the curves but still to include all practical conditions. In the case of a single-deck vessel no assumptions are necessary, since the length of stiffeners is the only question involved. However, in all other cases we have to deal with the height of bulkhead above the top of the stiffener in question. This involves the height of the 'tween decks. In this case a standard height of 'tween deck of 8 feet has been assumed. This is a pretty well standardized figure and in only a few cases will the variation from this height be great enough to affect the required section modulus of the lower stiffeners of the bulkhead. The assumption made appears reasonable and has simplified the curves to a large degree without, in the average case, limiting their application.

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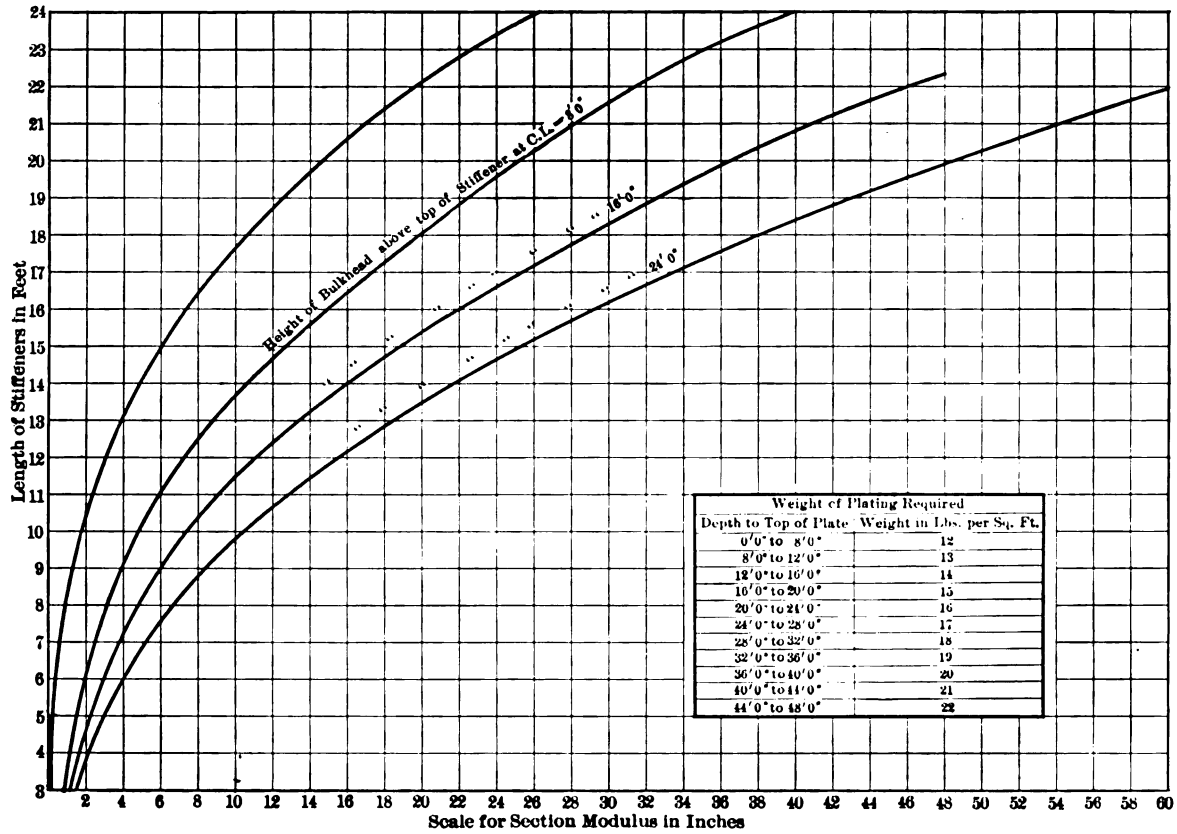
Length of Stiffeners in Feet
Height of Bulkhead above top of Stiffener at C.L.=8'0"
" " " "

of the lowest shell, tank top or deck bars to underside of deck should be used for entering the curves.

The height of the 'tween decks is to be taken on the center line of the ship.

As can be seen by the curves the application of these data is fairly wide and should cover all ordinary vessels constructed for cargo purposes. They are, of course, only applicable to vertical stiffeners on watertight bulkheads up to the following limits:

1. Single-deck vessels: (a) Single bottom up to 24 feet molded depth; (b) double bottom up to 26 feet molded depth.

2. Two-deck vessels: (a) Single bottom up to 32 feet molded depth; (b) double bottom up to 34 feet molded depth.

3. Three-deck vessels: (a) Single bottom up to 40 feet molded depth; (b) double bottom up to 44 feet molded depth.

4. Four-deck vessels: (a) Single bottom up to 48 feet molded depth; (b) double bottom up to 50 feet molded depth.

5. The above depths are to the strength deck only. Any number of upper decks may be added above the uppermost continuous watertight deck.

A Method of Finding the Indicated Horsepower for Steamships*

Calculations Depend on Standard Block Coefficient Based on Speed and Length of Vessel—Power Derived from Trial Data of Similar Vessels

BY E. W. DE RUSSETT

THE object of this paper is to suggest a ready means of estimating the power required for the propulsion of steamers which the writer initiated some years ago and has since developed. It will be observed that the calculations circle round a standard block coefficient which is based on the speed and length of the vessel. The power of the proposed vessel is arrived at by direct reference to the trial trip records of vessels of a similar character. The inquiry embraces the following rules:

1. For basis purposes select the trial trip records of two suitable vessels, A^2 and A^3, preferably of similar design to the proposed steamer A^1.

2. Find the speeds of A^2 and A^3 which correspond to the specified speed of A^1 by the ratio of $\sqrt{L}$.

3. Obtain the speed ratio at the corresponding speeds.

4. At the corresponding speeds measure the Admiralty coefficient from the coefficient curves of A^2 and A^3.

5. Find the standard block coefficient for vessels A^1, A^2 and A^3 by the following formula

$$C - \frac{V}{\sqrt{L} \times 2},$$

where C is a constant 1.060, V and L being the speed and length respectively. Compare the block coefficient of these two vessels with the standard block.

6. When the relative fineness or fullness of the ordinary

TABLE A

—	A^1.	A^2.	A^3.
	feet inches	feet inches	feet inches
Length B. P.	452 0	481 0	391 0
Breadth, extreme	56 6	55 5	48 2
Trial draft	27 8	27 5½	20 8
Block coefficient	0.778	0.730	0.678
Coefficient of midship section	0.98	0.974	0.965
Displacement, tons	15,540	15,190	7,500
Speed required	12 knots	—	—
Corresponding speed to A^1 by ratio of $\sqrt{L}$	—	12.38	11.16
Speed ratio on corresponding speeds $\frac{V}{\sqrt{L}}$	0.565	0.656	0.565
Standard block 1.060— $\frac{V}{\sqrt{L} \times 2}$ at corresponding speeds	0.778	0.778	0.778
Admiralty coefficient obtained on trial at corresponding speeds	—	308	304
Relative fineness of block to standard block	unaltered	6.2 per-cent finer	12.8 per-cent finer
Admiralty coefficient increased by 1 percent for each 3 percent of relative fineness (Table C)	—	2½ percent	4.3 percent
	—	= 6	= 13
Admiralty coefficient adjusted for relative fineness	—	314	317
Admiralty coefficient for A^1 ship, being mean of A^2 and A^3	315.5		
Corresponding indicated horsepower $\frac{D^{2/3} \times V^3}{C}$	3,400		
Margin on power for contingencies, 5 percent	170		
Total indicated horsepower	3,570		

TABLE B

Table Showing Estimate of Power required for a Vessel with a Cruiser Stern

	Proposed S.S.	Basis Vessels with Cruiser Sterns.	
	A^1.	A^2.	A^3.
	feet inches	feet inches	feet inches
Length, B. P.	530 0	580 0	306 0
Length on load waterline	550 0	600 0	317.6
Breadth, extreme	66 0	72 0	42 0
Trial draft, B.K.	27 0	28 5	15 0
Block coefficient	0.650	0.628	0.547
Coefficient of midship section	0.96	0.95	0.926
Displacement tons	18,080	21,920	3,118
Speed required on trial	17 knots	—	—
Corresponding speed to A^1 by ratio of $\sqrt{L}$	—	17.757	12.916
Speed ratio at corresponding speed $\frac{V}{\sqrt{L}}$	0.725	0.725	0.725
Standard block 1.060— $\frac{V}{\sqrt{L} \times 2}$ at corresponding speeds	0.697	0.697	0.697
Admiralty coefficient obtained on trial trip at corresponding speeds	—	345	309
Relative fineness of block coefficient to standard coefficient	†6 percent finer	9 percent. finer	21 percent finer
Admiralty coefficient increased by 1 percent for each 3 percent of relative fineness (Table C)	2 percent	3 percent = 10	7 percent = 21
Admiralty coefficient adjusted for relative fineness	—	355	330
Admiralty coefficient for A^1 ship, being mean of A^2 and A^3	343		
Add one-third of the relative fineness = 2 percent of the Admiralty coefficient	7†		
Admiralty coefficient	350		
Corresponding indicated horsepower $\frac{D^{2/3} \times V^3}{C}$	9,670		
Margin on power for contingencies, 5 percent	480		
Total indicated horsepower	10,150		

* Paper read at the North-East Coast Institution of Engineers and Shipbuilders, April 27, 1917.

† In this instance the block of the proposed vessel A^1 is 6 percent finer than the standard block, as economy of power was of more importance than deadweight. Credit for this is given, as noted above, when adjusting the Admiralty coefficient.

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and standard blocks has been found, correct the Admiralty coefficients at the corresponding speed ratios.

7. Of course it is prudent to have a margin of power for contingencies, and on this account it is suggested that an addition be made of 5 percent if the basis ships have been tried on the Skelmorlie mile, or 3 percent if they have been tried on the Whitley mile—the conditions being normal.

We will now refer to Tables A and B, which show the method of applying the foregoing rules. Column A^1 contains the particulars of an ordinary commercial vessel, the power for which has to be ascertained. Columns A^2 and A^3 contain the particulars of vessels which have been tried on the measured mile.

With the object of arriving at the effect of fineness of a model on the Admiralty coefficient, the writer has prepared the following Table C, with the kind assistance of Mr. H. Bocler. It is built up from the valuable paper read by Mr. Baker at the Institution of Naval Architects in 1914:

TABLE C
Effect of the Admiralty Coefficients on Models of Varying Degrees of Fineness

Models	Speed		Block		$D^{2/3}xV^3$ / I. H. P.	Admiralty Coefficient In percent to Basis Coefficient	I. H. P. at 50 perct. Propelling Efficiency
	Knots	Speed Ratios $\frac{V}{\sqrt{L}}$	—	Percent to Basis Model			
56*a*	8	0.40	0.677	8.8 percent finer	328	2.44 percent higher	695
30*b*	8	0.40	0.743	Basis.....	320	Basis.....	760
86*c*	8	0.40	0.812	9.3 percent fuller	279	12.8 percent lower	920
56*a*	9	0.45	0.677	8.8 percent finer	330	2.42 percent higher	980
30*b*	9	0.45	0.743	Basis.....	322	Basis.....	1,075
86*c*	9	0.45	0.812	9.3 percent fuller	276	14.2 percent lower	1,320
56*a*	10	0.50	0.677	8.8 percent finer	327	2.7 percent higher	1,360
30*b*	10	0.50	0.743	Basis.....	318	Basis.....	1,490
86*c*	10	0.50	0.812	9.3 percent fuller	264	15.4 percent lower	1,850
56*a*	11	0.55	0.677	8.8 percent finer	323	6.2 percent higher	1,835
30*b*	11	0.55	0.743	Basis.....	304	Basis.....	2,060
86*c*	11	0.55	0.812	9.3 percent fuller	265	12.8 percent lower	2,515
56*a*	12	0.60	0.677	8.8 percent finer	314	4.7 percent higher	2,450
30*b*	12	0.60	0.743	Basis.....	300	Basis.....	2,720
86*c*	12	0.60	0.812	9.3 percent fuller	251	16.3 percent lower	3,430
56*a*	13	0.65	0.677	8.8 percent finer	313	4.7½ percent higher	3,120
30*b*	13	0.65	0.743	Basis.....	299	Basis.....	3,470
56*a*	14	0.70	0.677	8.8 percent finer	313	11.8 percent higher	3,900
30*b*	14	0.70	0.743	Basis.....	280	Basis.....	4,600
56*a*	14.5	0.725	0.677	8.8 percent finer	312	22.4 percent higher	4,350
30*b*	14.5	0.725	0.743	Basis.....	255	Basis.....	5,640

It should be stated that the three models were for vessels each 400 feet long by 52.25 feet beam, and 23.25 draft, midship section coefficient 0.98. The displacements being for model 56*a*, 9,396 tons; model 30*b*, 10,310 tons; and 86*c*, 11,244 tons; the block coefficients being respectively 0.677, 0.743 and 0.812. The parallel middle bodies varied in length from 42 feet to 200 feet. It will be noticed when the basis model 30*b* was fined to the extent of 8.8 percent, the displacement reduced by 914 tons, and propelled at speeds 8, 9 and 10 knots (speed ratios 0.40 to 0.50), that the Admiralty coefficient was only raised on an average of 2.52 percent, or one-third of the percentage that the model was fined. When steaming under the same conditions at 11, 12 and 13 knots (speed ratio 0.55 to 0.65) the average Admiralty coefficient then rose by 5.4 percent above the basis model 30*b*, or about one-half of the percentage by which the model was made finer, and it was not until the speed of model 30*b* had been increased to 14 and 14½ knots (speed ratio 0.70 to 0.725) that the increase in the Admiralty coefficient was very pronounced, the average having risen to 17 percent above model 30*b*. When the basis model was filled out 9.3 percent and displacement increased by 934 tons, the effect on the coefficient was very apparent, it being reduced by a greater degree than had been gained by fining the model.

It is not intended that the standard block shall be unalterable; it is subject to amendment according to the exigencies of the case—but when any deviation occurs the percentage of relative fineness will, of course, be attended to, as illustrated in Tables A and B. It may be of interest to observe here that the block of the famous *Mauretania* was the same as the standard block herein referred to, when steaming at full speed on her forty-eight hours' trial.

A Submarine of One Hundred and Twenty Years Ago: Invented by Robert Fulton

BY F. B. C. BRADLEE

By most people the submarine is regarded as a recent invention, yet nearly 120 years ago Robert Fulton, the inventor of the world's first practical steamboat, perfected a submarine craft which it would seem would have been entirely successful after a few more trials and a little less scepticism on the part of the authorities.

In December, 1797, Fulton, who was then living in France, made an experiment in company with Mr. Joel Barlow (the United States Minister to France) on the Seine with a machine which he had constructed and by which he designed to impart to carcasses of gunpowder a progressive motion under water to a given point and there explode them. Although he was disappointed in the performance of this machine, he continued to employ his mind until he had perfected the plan for his submarine boat, as it was afterwards executed.

A want of funds prevented Fulton from carrying his plans into execution and he was induced to apply to the French Directory. They at first gave him great reason to expect their countenance and encouragement; but, after a long and irksome attendance on the public offices, to his great surprise and disappointment he received a note from the Minister of War informing him that the Directory had totally rejected his plan.

NAPOLEON TAKES UP FULTON'S PROJECT

But the French government changed. Napoleon placed himself at the head of it with the title of First Consul. Mr. Fulton soon presented an address to him, soliciting him to patronize the project of submarine navigation and praying him to appoint a commission with sufficient funds and powers to give the necessary assistance. The request was immediately granted and the famous scientists Volney, La Place and Monge were named the commissioners.

In the spring of the year 1801 Mr. Fulton repaired to Brest to make experiments with the plunging boat he had constructed the preceding winter. This had many imperfections natural to a first attempt of such complicated combinations. On July 3, 1801, he embarked with three companions on board his plunging boat in the harbor of Brest and descended in it to the depth of 5, 10, 15 and so on to the depth of 25 feet; but he did not attempt to go lower because he found that his imperfect machine would not bear the pressure of a greater depth.

Fulton and his companions remained below the surface one hour. During this time they were in utter darkness. Afterwards he descended with candles; but finding a

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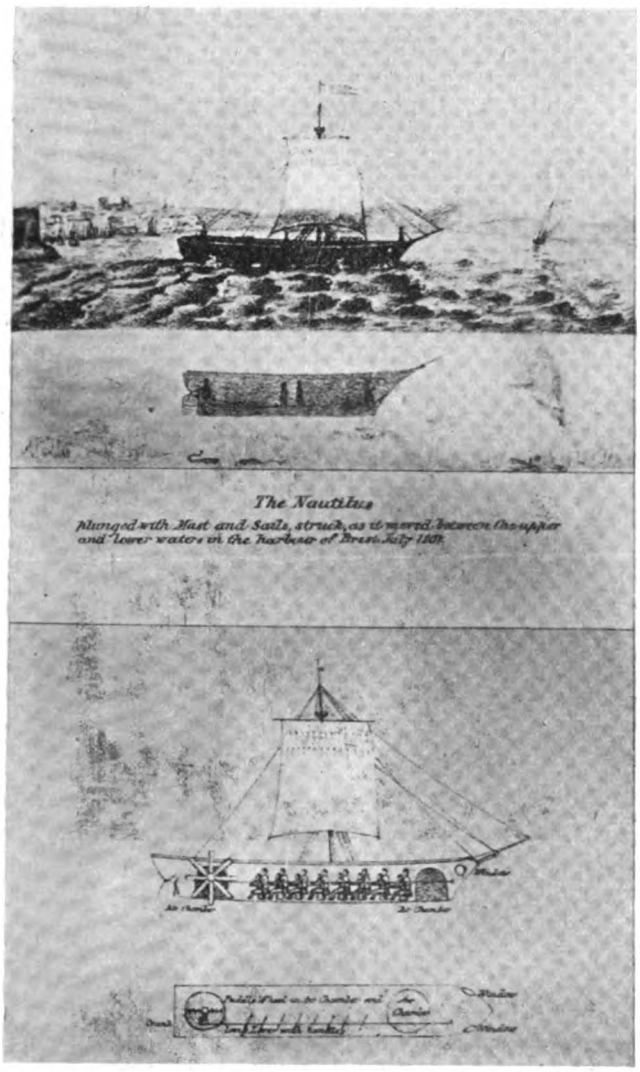
great disadvantage from their consumption of vital air, he had made before his next experiment a small window of thick glass measuring an inch and a half in diameter, just sufficient light to enable him to count the minutes on his watch.

Having satisfied himself that he could have sufficient light when under water, that he could do without fresh air for a considerable time, that he could descend to any depth and rise to the surface with facility, his next attention was given to his craft's movements on the surface as well as beneath it.

On July 26 he weighed his anchor and hoisted his sails; his boat had one mast, a mainsail and a jib. There was



Sketches of the Nautilus, Reproduced from Early Drawings

only a light breeze, but it was found she would steer and sail as well as any common sailboat. Fulton then struck her mast and sails, to do which and prepare the boat for plunging required about two minutes. Having plunged to a certain depth he placed two men at the engine which was intended to give the boat progressive motion, and with one man at the helm Fulton himself managed the machine which kept her submerged. He found that with the exertion of one hand only he could keep her at any depth he pleased. The propelling engine was then put in motion and he found upon coming to the surface that he had in about seven minutes made a progress of 500 yards.

He then again plunged, turned her round while under water and returned to near the place from which he started. Mr. Fulton repeated his experiment several days successfully and became familiar with the operation of the machinery and the movements of the boat. He found that she was as obedient to her helm under water as any boat could be on the surface and that the magnetic needle traversed as well in the one situation as in the other.

On August 7 Mr. Fulton again descended, with a store of atmospheric air compressed in a copper globe of a cubic foot capacity, into which 200 atmospheres were forced. Thus prepared he descended with three companions to the depth of about five feet. At the expiration of an hour and forty minutes he began to take small supplies of pure air from his reservoir and did so as he found occasion for four hours and twenty minutes. At the expiration of this time he came to the surface without having experienced any inconvenience from having been so long under water.

FULTON'S EXPERIMENTS SUCCESSFUL

Mr. Fulton was highly satisfied with the success of these experiments. It determined him to try the effects of these inventions on the English ships which were then blockading the coast of France and were daily near the harbor of Brest. His boat at this time he called the submarine boat, or the plunging boat; he afterwards gave it the name of the *Nautilus*. Connected with this machine were what he then called submarine bombs, to which he subsequently gave the name of torpedoes. This invention preceded the *Nautilus*. It was his desire of discovering the means of applying his torpedoes that turned Fulton's thoughts to a submarine boat.

Satisfied with the performance of his boat, his next object was to make some experiments with his torpedoes. A small vessel was anchored in the roads. With a bomb containing about twenty pounds of powder he approached to within 200 yards of the anchored vessel, struck her with the torpedo and blew her to atoms.

UNDER WATER WARFARE CONSIDERED DISHONORABLE

This experiment was made in the presence of the French admiral Villaret and a multitude of spectators. The committee of scientists to whom the submarine project had been referred were sceptical of its practicability and torpedoes were in those days considered a dishonorable method of waging war, so that both of Robert Fulton's ambitious projects came to naught. Had they been made use of, naval warfare might have been revolutionized over one hundred years ago.

Soon after the failure of his submarine boat Mr. Fulton returned to New York and began a series of experiments which resulted in 1807 in the *Clermont*, the world's first commercially successful steamboat.

GERMAN SHIPS RENAMED.—The United States Shipping Board announces the new names of the five German sailing vessels on the Pacific coast which were taken over and are now in service under charters from the Shipping Board. The names selected are those of the famous clipper ships of the forties and fifties, vessels which long ago disappeared from the seas.

The *Steinbeck* has been renamed the *Northern Light*. The *Kurt* has been renamed the *Dreadnaught*. The *Dalbeck* has been renamed the *Red Jacket*. The *Vinner* has been renamed the *Game Cock*. The *Ottawa* has been renamed the *Flying Cloud*.

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MARINE TERMINAL IMPROVEMENTS AT HOUSTON

New Wharves and Warehouses at Port of Houston, Texas

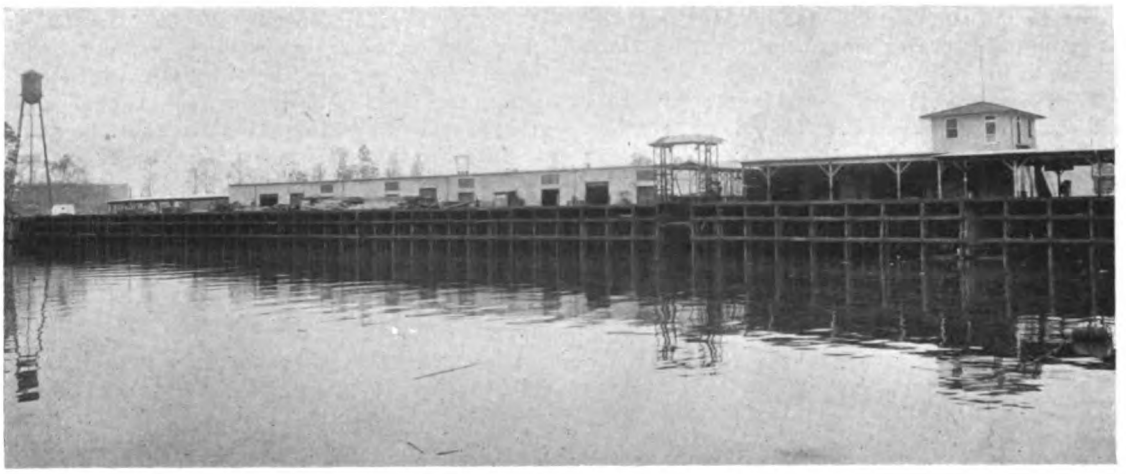

Fig. 1.—Water Side of Municipal Wharf No. 1

Fig. 2.—Railroad Connections to Municipal Wharf No. 4

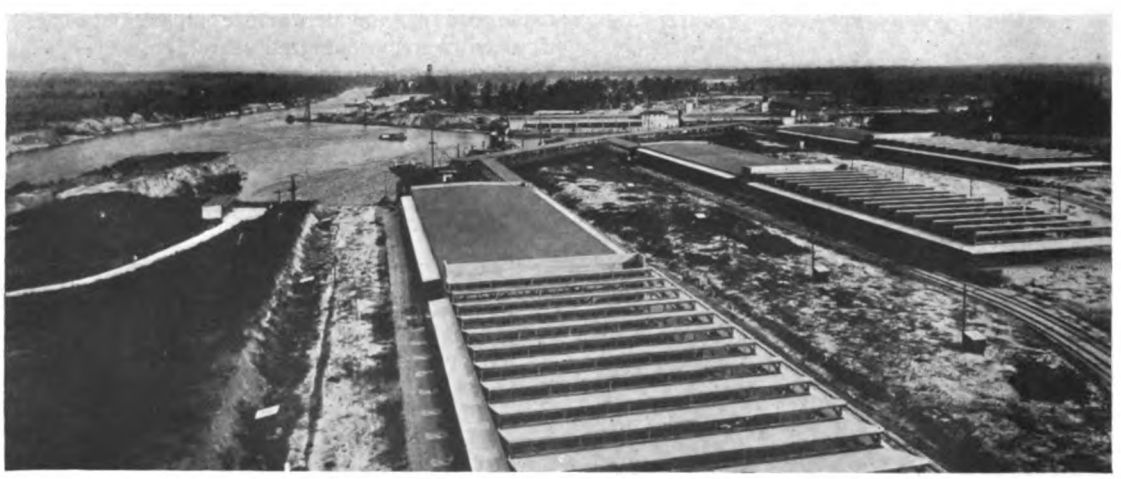

Fig. 3.—Bird's-Eye View of Municipal Cotton Docks

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Fig. 4.—Sea-Going Vessels Loading at Houston Municipal Wharves

Marine Terminal Improvements at Houston

New Municipal Wharves and Warehouses Built on Ship Channel at Houston, Tex., Fifty Miles from Gulf of Mexico

HOUSTON, TEX., the metropolis of the Southwest, is situated on the ship channel which connects the Port of Houston with the Gulf of Mexico through the Galveston Bay and Bolivar Roads. Its length is 50 miles with a minimum depth of 25 feet (terminating at the turning basin within the city limits). This great facility brings an enormous consuming territory 50 miles nearer to tidewater than other gulf ports. The turning basin is 1,100 feet wide on top, 980 feet on bottom and 26 feet deep. The channel is well marked with ranges and lights. All turns are figured on a minimum radius of 2,500 feet. Water in the upper channel is fresh. The channel has a land-locked harbor fronting both sides of more than 25 miles, safe and secure from storm, tides and overflows. The total cost of construction of the channel to date is $4,500,000 (£922,500).

Numerous large enterprises, some of them of national importance, are now located on the channel and others are making arrangements to take advantage of the industrial facilities provided by the ship channel and they are fast adding to the development of that splendid waterway. There has been marked activity during the past year, particularly, since the opening of the largest oil field in the south, which is located on the lower channel. Several large oil refineries are now under construction, besides other industries.

Construction of Marine Terminals

All marine terminals located at this port are municipally owned and controlled and are considered to be the finest and most substantial terminals in the United States, being constructed of reinforced concrete and all modern improvements.

Wharf No. 1 is now completed and in operation, being the first unit built. It is 650 feet long and has a concrete shed. The cubic capacity is 595,000 cubic feet. It has a square foot capacity of 94,550 feet, including apron, platforms and shed space.

Wharf No. 2 will be an open wharf and is now in course of construction. Its length is 504 feet. Its areal space will be 80,000 feet, which will cover shed space, if any shed is built on the wharf.

Wharf No. 3 will also be an open wharf connecting wharves Nos. 2 and 4. It is also under construction. This wharf will be 799 feet in length, having an areal space of 24,000 feet.

Wharf No. 4 is completed. It is 777 feet long, built of reinforced concrete, rat- and fireproof. The cubic foot capacity is 901,000 cubic feet and the areal space is 96,860 feet, including apron, platform and shed. Fig. 2 shows the track arrangement, also shed of the traveling conveyor for handling steel and machinery direct from ship to cars. The two uprights shown will be connected with a runway from the top of the shed to the retaining wall (across track) and connect with the new municipal storage warehouse.

The municipal cotton wharf and dock are now in operation and will accommodate 40,000 bales of cotton at one time. The height of the cotton wharf from the platform to the water surface is 28 feet.

Municipal Storage Warehouse

A modern concrete fireproof storage warehouse is now in course of construction and will be 400 feet wide by 600 feet long. This warehouse is being constructed right back of wharf No. 4 with all modern transportation facilities for safe and quick handling of freight. This warehouse, when completed including loading tracks, will cover six acres of ground.

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RAILROAD CONNECTIONS WITH WHARVES

The Port of Houston is belted with municipal owned railroad tracks, storage and classification yards. All railroads entering this port have now or will be given an opportunity to make physical connection with the municipal belt.

The construction outlined briefly above is only the beginning of the extensive improvements which will be made at Houston. So far the terminals will cost within the neighborhood of $3,000,000 (£615,000). It is contemplated making Houston the largest industrial concentrating and distributing port of the Southwest.

Why Is A Pen?

A Dissertation by "Old Mac" on Ruling Pens, Lettering Pens and Various Accessories

"SAY, Mr. Mac, what is the matter with my ruling pen? It got dull and the more I sharpen it the worse it seems to be."

"How did you find out that it was dull?"

"It would no longer draw a fine line."

"Huh! let me see it. You certainly have it sharp, all right. Too sharp, and the leaves are not the same shape. One is longer than the other. Why don't you sharpen your wits and give the pen a chance? Keep it clean, hold it loosely and you will not have to touch it for a long time. Don't try to take a roughing cut off the edge of your triangle and curves and don't dig a ditch in the cloth. Don't make fine lines unless a very fine scale drawing absolutely demands it.

"However, you have put this pen on the bum, and the only thing to do now is to fix it. The first thing is to get the outline of the leaves right. If you had a large pen and you were drawing heavy, straight lines, a full leaf outline like this (Fig. 1) would be best, because you could lean the pen over through a greater angle and because it

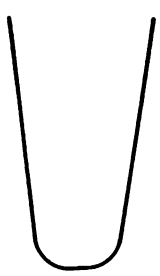

Fig. 1

Fig. 2

would hold more ink—you would not have to fill it so often. Your pen is small, and to get it easily around a sharp curve, a sharper outline like this (Fig. 2) will be best. A compass pen should have this outline and a small bow compass should have an even sharper outline.

"Now close the pen—not so tightly as to spring the leaves—and run it back and forth over a stone, holding it in a vertical position sideways and leaning it backwards and forwards. Don't grind off any more than is necessary to get the outline fair on both leaves. Now slack off on the screw. Take it out and open the leaves wide. Holding a leaf, point up, in the left hand rub down lightly with the stone in the right hand until the high light caused by the outline grinding has nearly disappeared. Do this over the whole outline, leaving the point a little dull.

"This is done for the reason that the ink, on account of its capillary attraction, will not work around a sharp edge and is therefore kept in the pen. Here is a section through the pen (Fig. 3).

"Resist the temptation to grind inside the leaves, because if it is done to any extent the point cannot be evenly and completely closed. There will be no burr to take off on the point if you leave it a little dull. If the stone leaves the surface a little scratched or rough, polish it by lighter rubbing or with oiled fine emery cloth. This polishing

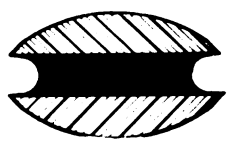

Fig. 3

keeps the ink from spreading or drying on the outside of the pen.

"Put a little oil on the screw. A small soapstone or fiber washer under the head of the screw will ease it up, especially if the pen has a strong spring to the leaves or is a little rusty. A large head to an evenly turning screw is a great advantage because you can adjust the thickness of the line by eye and with the thumb and first finger of the right hand alone. You will become so expert after a little that you will not have to try a line on the edge of the cloth, but will guess it the first time.

"If the pen clogs a little, as it will on hot, dry days, squeeze the leaves together either between the thumb and first finger of the right hand or against the little finger of the left hand. This breaks the crust of dried ink and starts the free flow.

"Oftentimes a finer line has to be drawn next to a heavy line that has been made by drawing several lines, as an angle shown against a plate in section, for example. In drawing the heavy line, ink was carried up on the outside of the point. If a finer line is now to be drawn, the ink on the outside of the pen makes a bad line—thicker than the pen was set for and ragged.

"When the heavy line is finished and without shifting the left hand on the triangle, just touch the point of the pen with the little finger of the left hand, cleaning off the ink before it has dried hard and distributing it over the finger so thinly that it immediately dries and cannot soil the tracing. If the pen is clean outside, there is very little surface exposed for drying up the ink. You see some fellows run the pen all over the border of the cloth and scratch lines all over the back of their hands in an effort to keep the ink running when all that is necessary is a little cleaning on the outside of the point.

"There are a lot of different kinds of pens, but the plain 45-cent variety (in times of peace) is the best. Keep a rag handy, and if the ink dries up, clean it and use more ink. Ink is cheap, and especially now that we do not have

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to buy it or mix it ourselves. If, after grinding, the pen feels too sharp and cuts the cloth, run it lightly over a stone to true up the leaves. You do not have to dig a ditch in the cloth, but merely start the ink to flowing and then move the pen along and let the ink trail out behind as if painting.

"Nearly always it is necessary to rub out, especially now that work is done on the cloth direct without pencil drawing. If you cut or scratch the cloth and then try to rub out, you will be in trouble. A lot of chalk rubbed on the cloth first helps in this way, also in that the ink dries quicker, does not penetrate into the fabric of the cloth and stays on top in a ridge that can be easily erased. The tracing does not wear as well, but lasts long enough. Don't run the pen so fast that the ink cannot flow out. The line will not be black and will be wavering and broken. Thin, fine lines are only excusable when rapid drying work is necessary and a good print or vandyke is not important.

"Remember that nowadays a tracing is made to convey information to the yard and as an office copy. It is not an advertisement of somebody's personality. Of course a draftsman has a certain amount of pride in his work, and neatness goes along with accurateness and carefulness, which are necessary; but remember that all these masterpieces that we sometimes try to make will be laughed at by the kids of a hundred years from now, just as we snicker at some of the funny yellow old shaded drawings with peculiar script printing that are now as out of style as wigs and knee breeches of the colonial days.

Lettering Pens

"What kind of a lettering pen have you? You can print with your ruling pen, you know. This is an advantage when the change to another pen would waste time. It is handy, but if you have much printing to do, a regular pen is better. Why do you kids always get a fine, sharp pen? It holds very little ink and scratches the cloth. It blots also if you are not very careful. Get a long-pointed stub, and after drawing the temper over a match flame, write with it on a stone, spreading the point and making eights or sixes, or writing up on a script tee until it is no longer sharp or rough.

"Old Man Higgins has a good scheme. He uses a ball-pointed pen in a flat penholder—flat, so that it will not

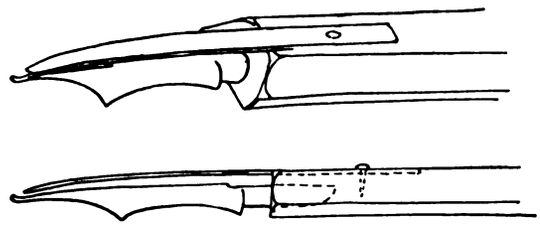

Fig. 4.—Old Man Higgins' Lettering Pen

turn in the hand. This holder is wood—Keuffel & Esser—10 cents (in times of peace), and the pen is a Lenard ball point, 506 F (there are other and finer sizes). He has taken a brass paper clip, straightened and flattened it out and fastened it to the back of the holder so that it projects down over the point of the pen and forms a pocket that can be filled with a relatively large quantity of ink.

"This fastening is a small, round-headed screw or a pin riveted through the holder. The spring of the projecting part is maintained by the part of the brass piece back of the pin or screw. The brass piece is turned at right angles to the holder and the back part bent down enough so that when it is turned back the projecting part is pressed against the point of the pen. A depression in the holder makes the clip line up and stay in line. You can load it up with a lot of ink and it will write black and heavy for a long while.

"Turning this pen on the side will cause it to write fine, making it suitable for small lettering in cramped places. It is cheap, will not blot and is the best all-around pen that I have seen. It don't scratch or cut the cloth, and lettering done with it can be easily erased. With the clip turned to the side it can be very easily cleaned. The old man has made about a dozen different styles of this pen. Get him to show you the latest improvement and how to handle it properly.

Eraser Holder

"Also get him to show you his new eraser holder. Like his pen it is home made, of wood. Two pieces hold the eraser in a slot and are wedged tight by a third wedge piece. He uses the ordinary ruby or emerald eraser, but the slot can be made to suit any size or shape of eraser.

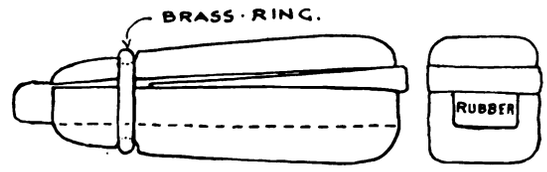

Fig. 5.—Convenient Eraser Holder

A brass ring that just slides over the nose of the holder when it is collapsed fits in a small groove and brings the pressure against the eraser when the wedge is pressed in the back. It will use up an eraser to the last quarter of an inch, and by only letting the eraser stick out a very little it is held firmly at the very edge, which is a great advantage in rubbing out against a shield. If ever you have much rubbing to do, such a holder will protect your hand wonderfully.

"He uses a fiber shield that he makes out of one of the stop cards in the index file (also home made). He claims that this is better than steel or German silver. Brass is dirty. Get him to show you the piece of glass he puts under the cloth when he has a particular job. He uses chalk under the cloth also. This holds the cloth from moving too much when pressure is great on the rubber and when it would otherwise roll up under the shield.

"While you are getting straightened out on pens, etc., and still have your lettering in the making, let me straighten you out on that also. You are not a natural letterer and you will have some hard work ahead of you. Use only an alphabet of vertical capitals, large and small, and do not use pencil guide lines. They are a waste of time and a crutch that you can easily learn to do without. If you do not use lines your printing automatically takes a size and spacing that makes it prominent and in proportion to the surrounding work. It is rapid because it takes time to draw the lines and they have to be rubbed out. Printing on lines is controlled by the lines and not by the surrounding work and is flat and monotonous. Get your style and don't change it. A No. 3 Pyzant pen is fine for titles. There are a couple of them around the office that you can borrow until you get a little flush and can buy one of your own. They make a large, clear, black rapid letter that dries readily. They don't blot.

"Go on over and cultivate Old Man Higgins."

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Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries—Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Care of Bearings

Perhaps one of the most frequent jobs that all engineers deal with is that of overhaul, adjustment, re-metalling, or refitting of bearings. This work on board ship involves a wide range of sizes, from the main shaft journals on down to the small brasses of the jacking or turning engine.

When a pound or knock is heard, the first thought is that some bearing has too much play or clearance, and you get busy to locate it. If the knock is an average one in sound, in the locating of it you must take plenty of time and be sure you are right when you note it down for adjustment at the end of the run. Many times a crosshead

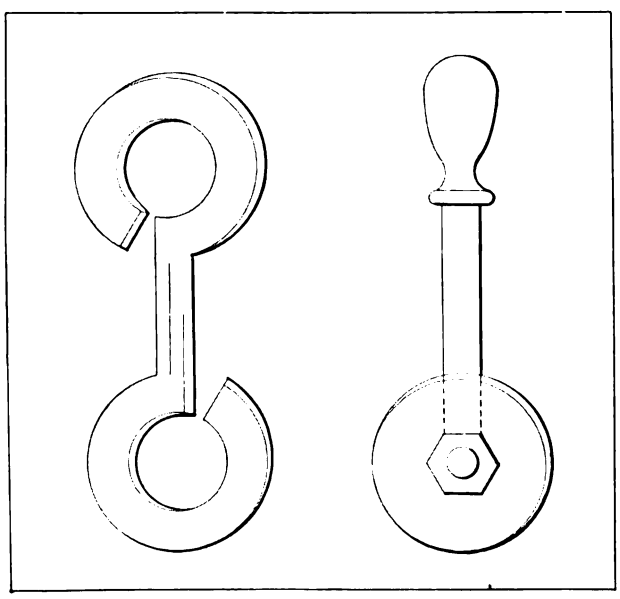

Fig. 1.—Scrapers for Refitting Large Bearings

brass is blamed for a knock that is in the line block of the nearby valve motion. Many main bearing caps have been unnecessarily refitted when the pound they were blamed for was in the crank next to them.

The easiest means of detecting the location of a knock is by flooding the suspected bearing with heavy oil and noting the change in sound. If the oil is consumed readily and cushions the journal, the sound is greatly softened and often stopped until the supply of oil has worked its way through, when, of course, the pounds will resume.

Very few slack bearings can be detected by the hand-feel method. This is true of large and small bearings alike. Many blower engine bearings have been burned up from keying up too tight when the knock was located by feeling out. High-speed engines should be dealt with patiently in finding the knock. After a pound has been located, the bearing nuts should be tried for slack. It is sometimes possible to get a little on each and eliminate the pound.

When necessary to reduce the clearance, before slacking the nuts, some definite means of marking their position should be used and these marks should be noted on a memorandum or other sure means of remembering them. After removing the cap and wiping the journal dry, a set of leads is taken (for babbit bearings, soft lead wire should always be used. Never use fuse wire, as it will cut into the babbit rather than compress, as it is very hard). The leads should be placed, the cap put back on and the nuts set up again to the marks. When setting up the nuts be sure to alternate, taking a little each time on the opposite nuts. Never take one side down more than the other. Many false leads have been made by improper care in fair setting up of the bolt strains.

Adjusting a Large Bearing

Having measured the thickness of each lead by wire gage, or micrometers, mark them on the bearing in pencil just where the lead lay in the cap, or draw a diagram of the cap and position of the leads. This gives you a record of the way your cap set before reducing the clearance. Assuming the clearance is too great, the next step will be to measure the liners or shims between the cap and lower half of bearing. If one of a few thousandths is among them, this can be removed and the next set of leads taken. It is generally found that the liners of large bearings are so assorted in thickness that there is always a thin .003 paper brass liner among them, but if not you will have to make such liners as will allow you to take out a few thousandths of an inch at a time, or as much as your set of leads show that you need to reduce the clearance. For example, say the bearing is a 14-inch main shaft; this requires 12 to 20 thousandths. You must reduce the liner thicknesses 6 thousandths.

It is generally found that some scraping is needed to relieve high spots or to give more clearance at the lips of the cap when a liner is removed. This work requires good tools and skill. Fig. 1 shows some scrapers that can be quite easily made and they will be found highly suitable for refitting large bearings. In removing metal for clearance by scraping always use a criss-cross stroke. Never confine your scraping strokes in any one or two directions and use extra care not to scrape too much from the ends of the cap, as this allows the oil to escape.

Having scraped and adjusted the bearing cap and removed the final set of leads, carefully blow out particles of dust with an air hose and wipe the liners off; then give the journal top a good coat of clean oil and assemble to the marks at which the last lead was taken. If each nut is set just a hair by the mark it insures the bearing cap being home.

Re-metalling or Babbiting

The first step is to melt out or chip out the old metal, then thoroughly to clean the parts to be re-metalled, also the melting pot and pouring ladles. There are several good ways to do this. If the bearings are small and removable they can be best cleaned by dipping them in the molten metal and leaving them there until the metal begins to sputter away from them. Another way is to heat them in a wood fire, pour some kerosene (paraffin) over them and let it burn off.

For cleaning the crucible and ladles sprinkle them well

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with fine rosin and burn this off in the forge fire. Tinning the surfaces of a small bearing helps to hold the metal, but is not essential if proper means are used to anchor the babbit. If the bearing to be cast is one which has given previous trouble in loosened metal, cut the anchor holes or dovetails deeper or add more of them. Always cast the bearing on end, if possible, as shown in Fig. 2, and for damming up use fireclay and asbestos or asbestos wicking and putty. Loam clay, if available, is very good, the main point being to construct a rigid dam that will not give way when the metal is poured. Back the damming up with

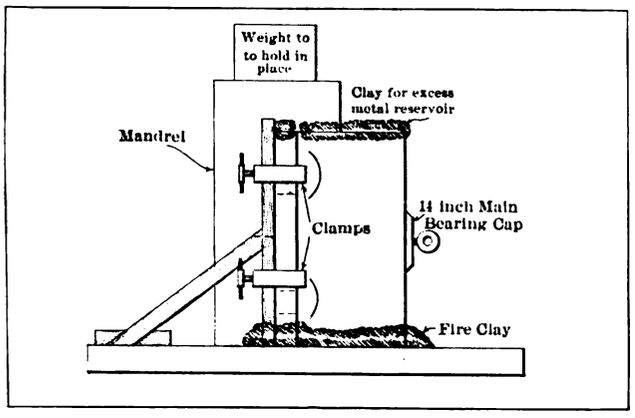

Fig. 2.—Method of Casting Bearing

strips of wood or packing, as shown in Fig. 2. Provide a riser, or excess metal trough, at the top to take care of the shrinkage.

Melting the Metal

Use a large size melting pot, one that will insure having plenty of metal to make the casting in one pour. Keep mixing or stirring the babbit while melting, dipping the ladle down to the bottom, bringing it up full and dumping it on the top of the pieces of melting babbit. Do not use too much old metal. Babbit metal which is used over too many times loses a large percentage of the tin and antimony each time it is re-melted, some being burned out. The dross or scum that floats on top of re-melted metal is the oxide formed by the combination of the metal with the oxygen of the air.

The work to be babbited should be very handy to the melting pot in order to retain the heat in the metal during pouring. Metal carried in a ladle any great distance is easily chilled and will not mold properly.

Heat the casting to be metaled to about half the heat of the melted babbit: never get the bearing too hot, as it will perhaps cause the liner to crack when cooled. The metal is ready to pour when a light pine stick held in the hot metal smokes or chars and transmits a trembling sensation to your hand. Skim off the dross when pouring, or before. Never completely empty a ladle when pouring. Hold back a little metal with which to dump out the dross.

The entire mold should be poured at once. To do this properly two ladles should be used and thus the stream of metal kept running. Any intermission in the pouring seldom joins well. Pour with care, slow at the start in order to see if the mold is tight at the base and to force out the air; then continue the pouring in a steady, fast stream. Continue until it overflows the riser, or excess metal reservoir. If there is room to puddle the metal while pouring it will pay well to do it. Use thin round iron rods and pump them up and down. This forces the air bubbles to the surface, also any impurities that may have flowed in the pouring.

After the cast has been made, if you desire a hard wearing surface, cool the mold at once with cold water, being careful to apply it gently to the shell and keeping it away from the molten metal. Apply it at the base first and slowly work upwards. This early cooling makes the metal much denser.

A good grade of babbit metal should always be used. The first cost may be somewhat high. High-grade tin babbit costs about one-half percent more than cheap babbit, but it pays bigger returns on the investment. If the bearing to be babbited is one that is to be bored out, the mandrel which is used should be much smaller to leave plenty of metal for boring. Such bearings should have the babbit additionally peened in to make it hard and denser. Use a round peen hammer and work from the center to the outer edge of the bearing. On the other hand, if the bearing to be cast is one that is to be scraped to fit, great care must be used to get the proper alinement of the mandrel. It must be the same size as the shaft, using just sufficient shims or liners to leave enough metal for scraping into a fit. The mandrel can be smeared with a thin coat of white lead if the bearing is of the small, solid type. When it is in two halves the liners should come close to the shaft, but have sufficient channel cut through them to have a free flow of metal to the lower half of the bearing shell.

Oil Grooves

A generous oil groove serves many purposes in a babbit-lined bearing.

1. A means of directing the distribution of the oil.
2. Providing a reservoir for oil.
3. A means of trapping the grit and dirt.
4. Affords a means of collecting the metal when a bearing slightly wipes from heating.

There are many approved ways for laying out the grooves. They should be deep, but not more than one-half the thickness of the lined metal. The edges should be

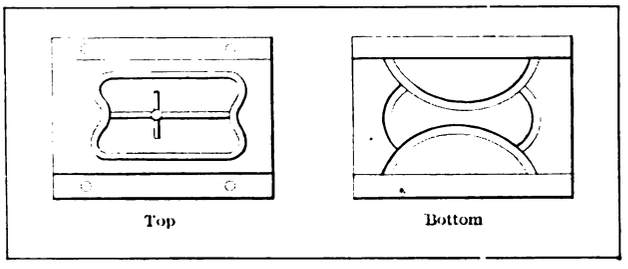

Fig. 3.—Layout of Oil Groves in Large Bearings

scraped rounding. A layout similar to that in Fig. 3 gives good results on large bearings.

For spiral grooving small bearings small-sized spring wire can be wound on the mandrel and coated with white lead. In winding start in the center and wind both right and left, stopping just short of the end. Oil grooves for small bearings are best cut by hand and with a curved round-nosed chisel, then finished with a scraper.

Concord, N. H. C. H. Willey.

Tight Pistons

Tight pistons and valves are, of course, absolutely essential—vital, in fact—to the economy of the reciprocating engine, and a piston that will remain tight in service and give the least trouble at the least expense is still a problem for the marine engineer.

Of course, when the cylinder is true and the piston a

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good fit, excellent results are obtained with almost any design for a while, but this condition lasts only a short while. The cylinder and piston immediately begin to wear away from this ideal condition and two conditions rapidly develop that must be remedied. One is, steam leakage past the piston, and the other is the lateral motion of the piston knocking against the walls of the cylinder at the top and bottom of the stroke.

With floating piston rod packings, very commonly used of late years, the lateral motion of the piston is more difficult to take care of than formerly because the packing

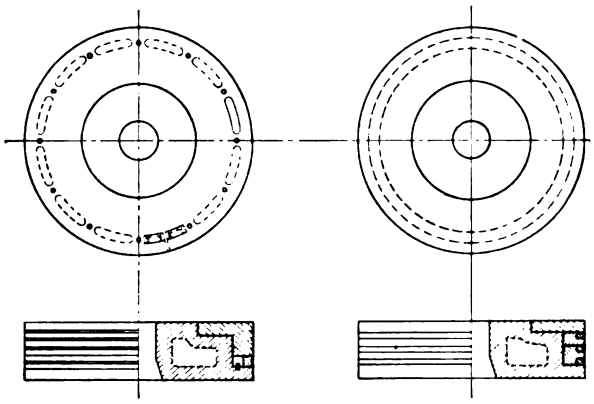

Fig. 1 Fig. 2

in the stuffing box forms no bearing or guide for the rod.

Our high pressure cylinder, 23½ inches diameter by 42 inches stroke, was originally fitted with a deep follower and a single packing ring 1¼ inches square section. This ring was set up by springs reacting against the body of the piston. The expansion of the ring was limited by a link fitted over lugs cast inside the ring at the point where cut. The idea was that the ring being restrained in this way could not exert undue pressure on the walls of the cylinder and minimum wear would be the result.

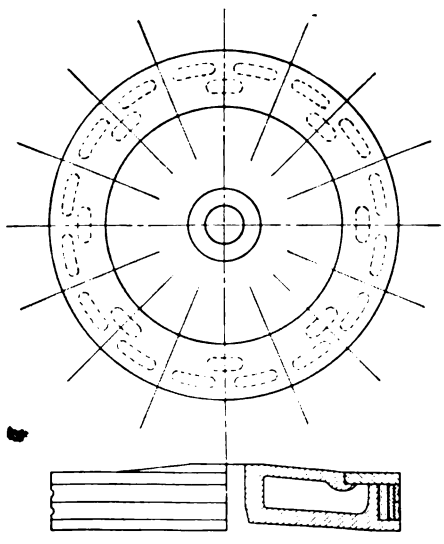

Fig. 3

The theory did not pan out, however. I have taken this ring out after a few days' wear and found it more than ⅛ inch smaller than the cylinder diameter. The original arrangement is shown in Fig. 1.

The inefficiency of the single restrained ring seemed clearly demonstrated by this time; also the follower and piston were appreciably worn, so a change was considered necessary. We turned out the edge of the deep follower and fitted the combination of bull rings and ramsbottom rings, as shown by Fig. 2.

This has been working satisfactorily for about two years, the spring rings lasting from three to five months (we run a little over 6,000 miles a month). In removing these snap rings, we are careful to caliper the cylinder and make the rings as thick radially as possible, completely filling the grooves provided for them in the bull rings. This takes care of the lateral motion of the piston.

Our intermediate pressure piston was fitted up originally the same as the original high pressure piston, Fig. 1. We changed the intermediate pressure piston later to a style similar to that shown in Fig. 2, only using two ramsbottom rings instead of three, as the space was too limited for three rings.

This was not so satisfactory as the high pressure piston, and we changed to the arrangement of Fig. 3. Here we found that if the springs were heavy enough to take care of the lateral motion of the piston, there was too much pressure on the rings, so we removed four rings and substituted neatly fitting cast iron radial blocks. These blocks hold the piston central, provide against any lateral movement and relieve the springs of any duty except to keep the packing rings set out against the walls of the cylinder.

While the piston arrangements described here are far from perfect, we have found them very satisfactory as improvements over the original designs, and hope they may be of interest to some one else having piston troubles.

Norfolk, Va. "X."

Economy Paragraphs

Provide your men with helpful information as to performance of their duties; do something for their personal comforts, both on and off watch.

Repair tools. A well-stocked tool locker with the best of tools saves time in emergencies—that's economy.

Sheet packing should be cut to templates with a sharp knife. Tons of packing are wasted by the crude method of cutting it on the flanges with a ball-peen hammer. It is only justifiable to use that method when saving time is urgent.

Do not burn the used waste; save and wash it—it can be used many times. W.

BOOK REVIEW

FRANK WATERHOUSE & COMPANY'S PACIFIC PORTS. Third edition. Edited by Welford Beaton. Size, 5 by 7½ inches. Pages, 350. Seattle, Wash.: 1917. The Terminal Publishing Company. Price, $3.00 net.

At a time when the attention of America is occupied so largely with foreign trade, this volume will prove a valuable addition to commercial literature, and any commercial house that is doing business on the Pacific Coast, or with any of the countries or islands of the Pacific, cannot very well afford to be without it. It is a commercial geography, a commercial dictionary, a transportation guide and a marine manual in one volume; attractively bound in limp leather and most carefully compiled for ready reference. A marine section, covering nearly 40 pages, contains excerpts from quarantine laws and regulations in force in the principal ports on the Pacific Coast and much other miscellaneous information that it is necessary for shipmasters and owners to have. Shipbuilding and ship repair companies and dry docks and marine railways are listed alphabetically.

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Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding will be Answered in this Department

BY H. A. EVERETT *

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so. Indicator cards taken from marine engines will be carefully analyzed, the defects pointed out and the horsepower calculated, provided complete data are sent with cards.

Relieving Excess Pressure in Boilers

Q. (892).—How should the water in the boiler be changed while steam is up if the safety valve was stuck? How would the pressure on the boiler be relieved if the steam was up and could not make its escape?

A. (892).—It is difficult to surmise the exact point of your query. If the second part means what would happen if no outlet was opened from the boiler and steam continued to be generated, the answer is that the pressure would increase until ultimately it reached a point when explosion of the boiler would occur. If the first part means what should be done in an emergency when the safety valve is stuck and the main stop-valve cannot be opened, the answer is, draw fires.

Receiver Pressures in Compound or Triple Expansion Marine Engines

Q. (882).—How are the receiver pressures determined in a compound or triple expansion marine engine, so that each cylinder is doing an equal amount of work? Does this have to be done with indicator cards? Please give an example showing how it is done: engines, high pressure, 27½ inches; intermediate pressure, 34½ inches; low pressure, 50 inches diameter; stroke, 36 inches; working pressure, 185 pounds per square inch. Engine designed to develop 1,600 horsepower.

A. (882).—The receiver pressures in an engine already built are controlled by the valve settings for the various cylinders, and while the hypothetical pressures to give equal work in each cylinder may be predicted, they are not good criterions by which to judge the engine condition. The best information as to adjustment of an engine for either maximum output or maximum economy of steam is that given by Prof. Wrighton's † investigation of best cut-off.

This states that for maximum *economy* cut-off should occur as follows:

$$\text{Cut-off for maximum economy} = 0.15 + \frac{1}{R} \text{ when } R \text{ is}$$

the ratio of capacities of the cylinder under discussion to the preceding cylinder.

Cut-off for maximum power

$$\text{Intermediate-pressure cylinder} = 1.4\left(0.15 + \frac{1}{R}\right)$$

$$\text{Low-pressure cylinder} = \left(0.15 + \frac{1}{R}\right)$$

same as for maximum economy.

For your case this would mean that for maximum economy you should operate with the cut-offs for intermediate at

$$0.15 + \left(\frac{27.5}{34.5}\right)^2 = 79 \text{ percent of stroke,}$$

and for low at

$$0.15 + \left(\frac{34.5}{50.0}\right)^2 = 63 \text{ percent of stroke.}$$

For maximum power you should operate at cut-offs, for intermediate as late as gear will permit, and for low the same as for maximum economy (63 percent).

Annealing of Welded Bronze Propeller Wheels

Q. (895).—Will you kindly furnish an opinion on a question about which there is a difference of opinion? The circumstances of the case are as follows: A bronze four-bladed solid propeller of about 15 feet diameter had one of its blades broken off about one-third of its length and a new part was cast of the same bronze, which was welded on by the acetylene process. The wheel was put in service and after several trips the same blade broke off, not, however, in the weld, but about 6 inches beyond the weld toward the end of the blade. When welding this blade the first time, the heat was applied only along the welded portion about 6 to 8 inches each side of the weld. The blades are about 3 feet wide and the center section about 3 inches thick.

A second weld was made in a different manner. A mold was made of the opposite blade and the new cast piece of blade was made out of the same bronze material and laid with the broken blade in the mold, after both the broken end and the end of the new cast piece had been prepared for welding. The whole blade was heated to a uniform heat while welding.

Several English marine engineers contend that the first welded blade broke because the whole propeller was not annealed, and that the second welded piece will also break off if the whole wheel is not annealed as they do in England. The writer and several American engineers who have had experience in bronze mixtures and bronze wheels have never heard of bronze wheels being annealed, and therefore would appreciate your opinion regarding this matter.

A. (895).—It is not the custom in this country to anneal bronze propellers, and I have never heard of it being considered necessary. The failures occurring as you mention are more likely attributable to faulty material or improper design in not allowing sufficient thickness of blade to withstand the stress. Some yards make slight repairs to bronze propellers by welding in patches by the oxy-acetylene process. If the designed thickness is sufficient, the repair as given in your second method should be good without annealing the whole wheel. The blade failed at about the point where calculations usually show the greatest stress, and this leads to the suspicion that the original design may have been faulty.

Boiler Horsepower

Q. (890).—A boiler evaporates 28,930 pounds of feed water from a temperature of 127 degrees into steam at 85 pounds pressure during a run of ten hours. What horsepower is developed by the boiler?

A. (890).—One boiler horsepower is defined as the "evaporation of 34.5 pounds of water per hour from and at 212 degrees F.," which is equivalent to 33,479 B. T. U.'s or 33,455 B. T. U.'s, according to whether we use the heat of vaporization at 212 degrees of 970.4 B. T. U.'s as given by Mark's and Davis' Tables or 969.7 B. T. U.'s as given by Peabody. To raise one pound of water from 127 degrees F. to 316.3 degrees F., which is the boiling temperature corresponding to 85 pounds (absolute) requires q 316.3° — q 127°, or 286.5 — 95 = 191.5 B. T. U.'s. To vaporize one pound at this pressure into dry steam requires the latent heat or heat of vaporization of 896.6 B. T. U.'s, so that the total heat spent on the feed water to get it into

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* Professor of Marine Engineering, Post Graduate Department, United States Naval Academy, Annapolis, Md.

† "Receiver Drop in Multiple Expansion Engines." N. E. Coast Institute of Engineers and Shipbuilders, Vol. XVI.

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steam at 85 pounds (absolute) is 191.5 + 897 = 1,088.5 B. T. U.'s. The boiler produces 2,893 pounds of steam per hour, which is equivalent to 2,893 × 1,088.1 = 3,149,000 B. T. U.'s. This corresponds to a boiler horsepower of 3,149,000 ÷ 33,479 = 94.

Another and shorter way of doing this same problem is to make use of a table of "factors of evaporation" as given in most hand books which converts the *actual* evaporation into *equivalent* evaporation from and at 212 degrees by a single multiplication. From such a table ("Steam," Babcock & Wilcox Company) the factor for the above condition of 127 degrees feed and 85 pounds absolute pressure is 1.1216, so that the equivalent evaporation is

$$\frac{28930}{10} \times 1.1216 = 3243 \text{ pounds per hour,}$$

and the boiler horsepower is 3,243 ÷ 34.5 = 94.

Constants for Horsepower

Q. (894).—Will you kindly tell me (a) how to find constants for horsepower for an engine 22 by 37 by 60 inches by 42 inches stroke and how to apply it with varying piston speeds and steam pressures? Please supply the necessary data besides size of engine. Also (b) if a ship makes 18 miles (15.63 knots) at 100 revolutions per minute with 25 percent slip, what distance will she make with 125 revolutions and 20 percent slip?

A. (894).—(a) The general expression for indicated horsepower is

$$\frac{2PLAN}{33{,}000}.$$

where P = mean effective pressure (pounds per square inch),
L = length of stroke in feet.
A = area of piston in square inches (net),
N = number of revolutions per minute.

Assume 6-inch diameter piston rods for all cylinders and no tail rods (area 6-inch rod = 28 square inches).

For any given cylinder the only items which can vary in the above expression are P and N, so the engine constant becomes:

$$C = \frac{2LA}{33{,}000}, \text{ and then } I.H.P. = C \times P \times N,$$

$$C_{high} = \frac{2 \times 3.5\left(380 - \frac{28}{2}\right)}{33{,}000} = .0777.$$

$$C_{int} = \frac{2 \times 3.5\left(1075 - \frac{28}{2}\right)}{33{,}000} = .225.$$

$$C_{low} = \frac{2 \times 3.5\left(2827 - \frac{28}{2}\right)}{33{,}000} = .597.$$

These constants multiplied by the average of the top and bottom mean effective pressures and by the revolutions per minute will give the indicated horsepower for the individual cylinders. The area used is the average of the top and bottom areas (the top area minus one-half rod area for this case) and if more refinement were desired a constant for each end could be worked out, using the actual area of that end and omitting the factor 2. Then the mean effective pressure of each end of each cylinder would be multiplied by the constant for that end and all summed to get the total indicated horsepower. It is rarely, however, that the accuracy of the indicator diagrams warrants this refinement, and the constants as derived above serve all practical needs. To make the problem complete, assume the following mean effective pressures to have been worked up from the cards averaging those for the top and bottom ends of each cylinder:

M. E. P., High = 70 pounds per square inch,
Int. = 38 pounds per square inch,
Low = 14 pounds per square inch,
R. P. M. = 75.

Then *I. H. P.*, High = .0777 × 80 × 75 = 466
Int. = .225 × 35 × 75 = 590
Low = .597 × 13.5 × 75 = 604
Total I. H. P. = 1660

(b) The expression for apparent slip is

$$S = \frac{PR - 101.3V}{PR}$$

where S is apparent slip expressed decimally,
P is pitch of the propeller in feet,
R is revolutions per minute of the propeller,
V is speed of the ship in knots.

From this the pitch is

$$0.25 = \frac{P \times 100 - 101.3 \times 15.63}{P \times 100},$$

$$P = 21.1$$

Using the above pitch the *speed* at 125 revolutions per minute and 20 percent apparent slip will be

$$0.20 = \frac{21.1 \times 125 - 101.3V}{21.1 \times 125},$$

$$V = 20.8 \text{ knots.}$$

It should be noted that the data given are impossible. the increase of revolutions per minute is accompanied by a decrease in apparent slip when actually it is always accompanied by an increase in apparent slip.

Heat Transfer in Oil Cooler

Q. (878).—Will you please give us some assistance in settling the following point which has come up in testing an oil cooler? In finding the B. T. U. transmitted per square foot, per degree difference of temperature, it is necessary to divide the total B. T. U. transmitted by the heating surface and by the *mean* temperature difference.

Gebhardt, "Steam Power Plant Engineering," page 563, gives the following formula for mean temperature difference:

$$\text{Mean temperature difference} = \frac{t - t'}{LOG_e \frac{t}{t'}}$$

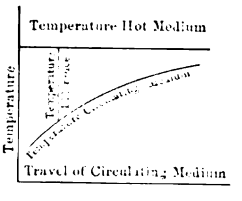
in which t is the original temperature difference and t' the final temperature difference of the two fluids.

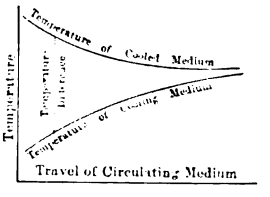
In one of our runs we had the following observations:

Inlet temperature oil	120.4 degrees F.
Outlet temperature oil	107.0 degrees F.
Inlet temperature cooling water	79.6 degrees F.
Outlet temperature cooling water	93.1 degrees F.

As this is a counter-current cooler, the original temperature difference $= t = 120.4$ degrees $- 93.1$ degrees $= 27.3$ degrees, and final temperature difference $= t' = 107.0$ degrees $- 79.6$ degrees $= 27.4$ degrees. In other words, the initial and final temperature differences are about the same, and when we substitute these values in the formula for mean temperature difference, we get an absurd value.

A. (878).—As long as the amount of heat transferred per square foot of surface is considered to be directly proportional to the difference of temperature existing on the two sides of the surface the expression given for mean temperature difference is correct for any sort of heat transfer apparatus.





When T_1 and T_2 are nearly equal, though, this expression becomes unstable, and when $T_1 = T_2$ it is indeterminate. The mean temperature difference for these cases is, then, best determined by taking the arithmetic mean.

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Shipbuilding and General Marine News

Contracts for New Ships—Marine Terminal Improvements—Recent Launchings—Improved Appliances—Personal Items

American Shipbuilding Doubled in a Year

According to figures submitted to the United States Senate on June 1 by Vice-Chairman Brent of the United States Shipping Board, the total merchant construction in American shipyards, including completed and undelivered vessels under contract, for all persons, corporations or governments other than the United States, on May 1, 1917, was 537 steel ships, aggregating 2,039,261 tons, and 167 wooden ships, aggregating 214,753 tons. On May 1, 1916, the construction in American shipyards included 368 steel ships, totaling 1,129,014 gross tons. Wooden ships were not reported.

These figures show an increase in total steel construction on hand of nearly 100 percent over that of the corresponding date a year ago. The total increase in the amount of work on hand since January 1 of this year is nearly 600,000 tons.

Shipbuilding Contracts Let by Shipping Board Corporation

The United States Shipping Board Emergency Fleet Corporation, Washington, D. C., has announced the following contracts, in addition to those mentioned in our last issue:

Sloan Shipyards Corporation, Seattle Wash.—Sixteen wooden cargo carrying steamers complete; first steamer to be delivered January 31, 1918; two in February, 1918; four in March, 1918; two in April, 1918; two in May, 1918; two in June, 1918; two in July, 1918.

Gray's Harbor Motor Ship Corporation, Aberdeen, Wash.—four wooden hulls; first hull to be delivered January 15, 1918; second, February 15, 1918; third, March 15, 1918; fourth, April 15, 1918.

Coast Shipbuilding Company, Portland, Ore.—Four wooden hulls; first hull to be delivered January 1, 1918; second, March 1, 1918; third, May 1, 1918; fourth, July 1, 1918.

Edward F. Terry & Henry L. Brittain, 60 Broadway, New York City—Works, Moss Point, Miss.—Twenty composite cargo carrying steamers complete; first steamer to be delivered February 1, 1918, and the remaining 19 within next ten months.

Skinner & Eddy Corporation, Seattle, Wash.—Six steel cargo carying steamers complete; first two steamers to be delivered within five months from date of arrival of keel plates, and of the remaining number of steamers the building of the second two steamers shall be commenced immediately after the completion of the first two steamers, and shall be delivered within five months after the laying of the keels, and the building of the remaining two steamers shall be commenced immediately after the completion of the second two steamers, and shall be delivered within five months after the laying of the keels.

Sanderson & Porter, 52 William street, New York City—Works, Willapa Harbor.—Ten (10) wooden hulls; first hull to be delivered on April 1, 1918, and one hull every fifteen (15) days thereafter, ending August 30, 1918.

The Maryland Ship Building Company, Lexington building, Baltimore, Md.—Works, Sollars Point, Md.—Six (6) wooden hulls; first hull to be delivered April 30, 1918, and one hull to be delivered on the last day of each succeeding month, ending September 30, 1918.

The Seattle Construction & Dry Dock Company, Seattle, Wash.—Ten steel steamships; first and second to be delivered in June, 1918, and thereafter at intervals until the tenth ship is delivered in December, 1918.

The Foundation Company, 233 Broadway, New York.—Ten wooden hulls; the first to be delivered March 6, 1918, and one every fifteen days thereafter.

The Groton Iron Works, Noank, Conn.—Twelve wooden hulls; the first hull to be delivered in five months after receipt of lumber for keels and one hull every fortnight thereafter.

The Ship Construction & Trading Company, Stonington, Conn.—Two wooden hulls; one to be completed February, 1918, and one March, 1918.

The Traylor Shipbuilding Company (a subsidiary of the Traylor Engineering & Manufacturing Company, Allentown, Pa.)—Ten wooden vessels; the first to be delivered in January, 1918, and one each month thereafter.

Summary to date (June 18):

Total number of contracts executed	16
Total number of ships and hulls contracted for	138
Complete steel ships	28
Complete composite ships	32
Complete wooden ships	30
Total complete ships	90
Wooden hulls	48

Wooden Shipbuilders of the Northwest Organize

In order to insure that the State of Washington shall secure her share of the wooden shipbuilding contracts to be made by the United States Shipping Board, a number of wooden shipbuilders of the Puget Sound and Gray's Harbor district have completed preliminary plans for organizing the Wooden Shipbuilders' Association of the North Pacific.

It is proposed by the wooden shipbuilders to organize a commissary department for the purchase of supplies for the different yards, and that the lumbermen be requested to have a committee meet with the shipbuilders that they may co-operate in an effort to get the best results.

Patrol Ship Inspection

George Uhler, Supervising Inspector-General, Steamboat Inspection Service, of the Department of Commerce, has sent the following instructions to United States supervising, local and assistant inspectors:

"As it is probable that requests will be received by you from the special board for patrol vessels for the examination of vessels suitable for this purpose, you are directed to co-operate at once, upon receipt of such requests, to the fullest extent in this work.

"At this critical time results are desired, and therefore there must be no delay in your hearty co-operation."

Shipbuilding Contracts

The McMyler Interstate Company has received a contract from the Navy Department for furnishing shipbuilding frames at the Puget Sound Navy Yard at a cost of $230,727.

The Seattle Machine Works, Seattle, Wash., has received a contract from the Skinner & Eddy Shipbuilding Corporation for two sets of triple-expansion engines of 2,700 horsepower each.

The Mathews Shipbuilding Company, Hoquiam, Wash., has received a contract from the E. K. Wood Lumber Company, San Francisco, Cal., to build a twin-screw wooden motor ship 170 feet long.

It is reported that the Union Bridge & Construction Company, Kansas City, Mo., will build ten ships for the Shipping Board at its new yard to be constructed at Morgan City, La.

The Newport News Shipbuilding & Dry Dock Company, Newport News, Va., has received a contract from the Savannah Line, Pier 35, North River, New York, for a duplicate of the *City of St. Louis*, the flagship of the Savannah Line's fleet. Delivery is to be made in twenty months.

To J. W. Norcross, vice-president and managing director of the Canada Steamship Lines, Ltd., Montreal, Canada, has been delegated by the Canadian Government the work of having built in Canada 36 steel steam trawlers and 100 wooden steam drifters.

It is officially announced that the Bethlehem Steel Corporation, South Bethlehem, Pa., has about 135 steel vessels under construction or under contract at its various shipbuilding plants.

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A Battleship on Shore—U. S. S. *Recruit*, Naval Recruiting Station in Union Square, New York City

Boys Under 17 Not to Be Enlisted in Naval Service

Secretary of the Navy Daniels has issued the following order:

"Inasmuch as the rate at which recruits are being obtained is satisfactory, and as it is undesirable at present to take into the naval service young boys, whose education is not completed, it is directed that until further orders no enlistments in the Navy or Marine Corps, or enlistments in the Naval Reserve Force or Marine Corps Reserve, be made of boys less than 17 years of age."

Nomination of Midshipmen to the U. S. Naval Academy

The Navy Department authorizes the following: The first nominations are coming in for the increase of 531 'midshipmen at the United States Naval Academy. Congress passed an act on April 25 providing an additional appointment for each Senator, Representative and Delegate, and the candidates will soon be designated for the examinations, which are to be held at civil service examination points throughout the country on June 27.

After the mental examinations are completed ,the papers will be sent to the academy to be marked and graded, and those who have passed will be given the physical examination at Annapolis.

There are now in the academy 940 'midshipmen. The 183 in the class graduated on March 29 would, in the ordinary course, be commissioned as ensigns July 1. They are now in the service, and a bill has passed the House and has been favorably reported to the Senate to commission them as ensigns at once. Another class of 202 will be graduated early in September.

To accommodate the large increase in the number of 'midshipmen at the academy, temporary quarters are being built. About 1,250 can be accommodated in the present building, and with the addition of the new quarters there will be provision for between 1,500 and 1,600.

Herreshoff Manufacturing Company Re-Organized

The Herreshoff Manufacturing Company, Bristol, R. I., famous for the design and construction of American cup defenders and other racing yachts, was recently reorganized and the following officers elected: President, N. H. Herreshoff. Bristol, R. I.; vice-president, A. Loring Swasey, Taunton, Mass.; treasurer, Robert W. Emmons, 2d, Boston, Mass.; secretary, C. W. Young, Bristol, R. I.; general manager, James Swan, Bristol, R. I.

The directors are N. H. Herreshoff, James Swan, A. Loring Swasey, R. W. Emmons, 2d, George Nichols, New York City; C. F. Adams, Boston, Mass.; H. P. Whitney, New York; I. Lewis Stackpole, Boston, Mass., and I. MacDowell Garfield. Boston, Mass.

The Herreshoff Manufacturing Company now has a very large amount of work under contract, including three steel patrol boats, 110 feet in length, of 1,200 horsepower, with oil-burning watertube boilers; also two 80-foot wooden patrol boats, burning oil fuel, and ten 62-foot patrol boats with gasoline engines. The company has recently completed the 114-foot steam yacht *Navette* for J. P. Morgan, which on a trial course of 16 nautical miles showed a speed of 20.6 knots, this being 1.6 knots in excess of contract requirements. The company has also completed the 58-foot motor yacht *Lady Gay* for Mrs. J. P. Lippincott, Philadelphia, Pa.

Recent Launchings

The 11,000-ton oil tanker *Pennsylvania* (June 9), building for the Texas Company, New York, at the Fore River Shipbuilding Corporation, Quincy, Mass.

The 240-foot steam yacht *Isabel*, for John N. Willys, president of the Willys-Overland Company, building by the Bath Iron Works, Ltd., Bath, Me., in accordance with designs by Cox & Stevens, naval architects, New York. This vessel was taken over by the Government in May.

A 230-ton schooner (May 22), building by Sidney Jones, of Weymouth, Nova Scotia, for the Standard Oil Company.

The 14,900-ton Isherwood framed oil tanker *W. C. Teagle* (June 9), building for the Standard Oil Company of New

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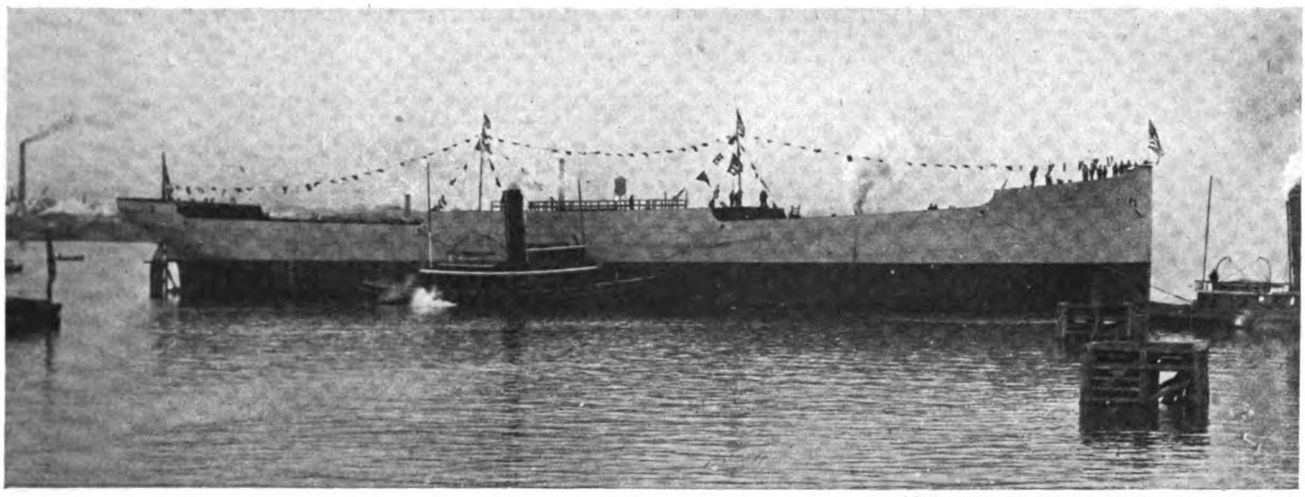

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Launching of S. S. *Scandanavic* at Shooters Island Yard of Standard Shipbuilding Company, New York, on May 29

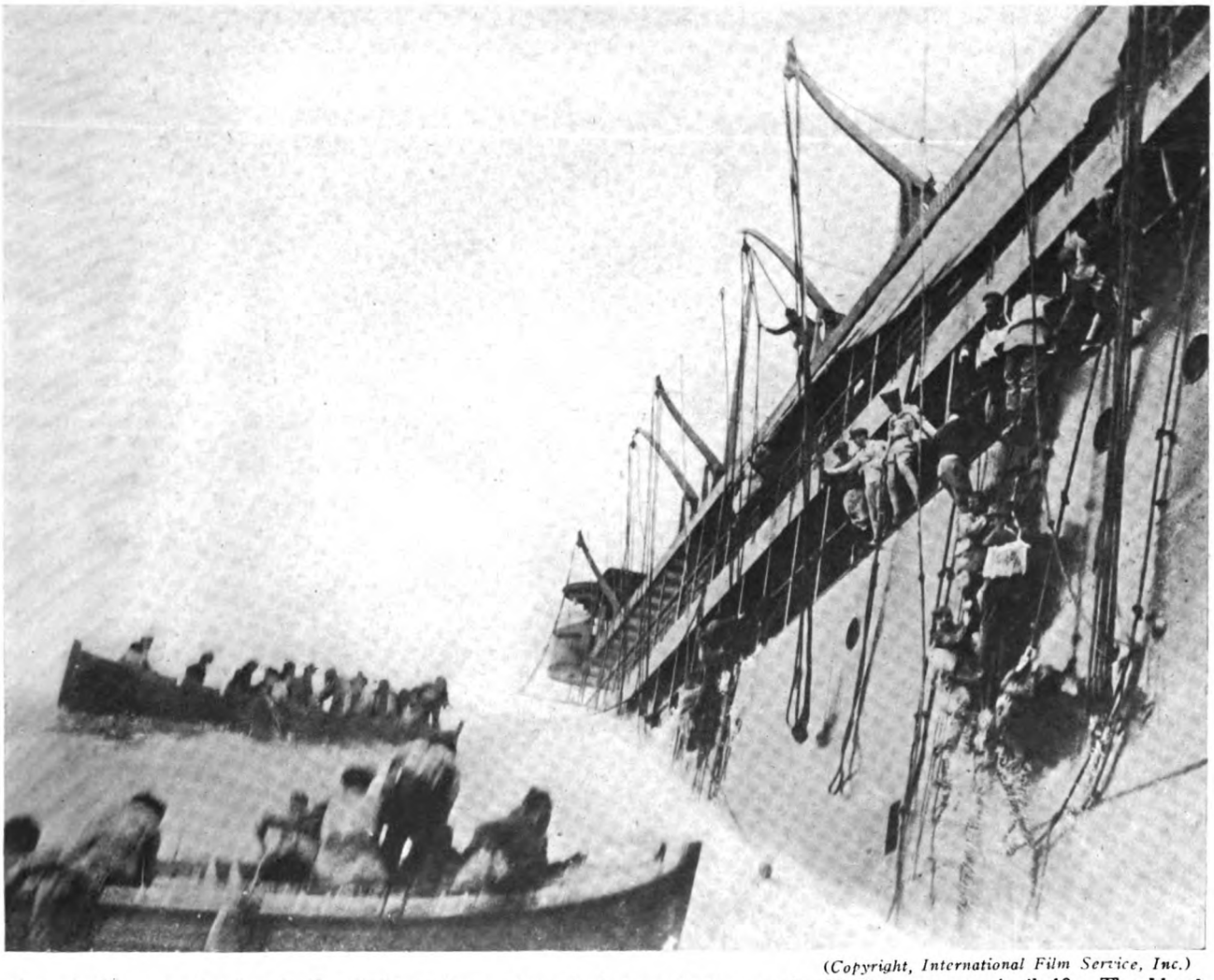
Jersey by the Bethlehem Steel Company, Maryland Plant, Sparrows Point, Md.

The oil tanker *William Isom*, of 5,000 tons deadweight capacity, building for the Sinclair Gulf Corporation by the Baltimore Dry Docks & Shipbuilding Company, Baltimore, Md.

The sea-going barge *Glenside* (June 9), building for the Reading Transportation Company, Philadelphia, by the Coastwise Shipbuilding Company, Baltimore, Md.

A 100-foot open lighter (June 9), building for the Maryland Transportation Company by Chas. Rhode & Sons Company, Baltimore.

The cargo steamship *Scandinavic*, of 7,300 tons deadweight



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Last of Passengers Leaving the French Liner *Sontay*, Torpedoed by a U-Boat in the Mediterranean on April 10. The Vessel Sank in 4 Minutes. Forty-five Persons, Including the Commander, Were Lost

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carrying capacity (May 29), building by the Standard Shipbuilding Corporation, New York, at their plant on Shooters Island, for the Atlantic Transportation Company, Gothenburg, Sweden.

Shipyard News

The South Jersey Shipbuilding Company, Camden, N. J., has been incorporated, with a capital of $125,000, to establish a shipbuilding plant at Leesburg, on the Maurice River. The company is said to have acquired waterfront property at this location for the proposed works, which will be equipped to specialize in the manufacture of vessels of wooden type for coast service. The incorporators of the company are Howard Compton, Leesburg; Albert D. Cummins, 207 Westmont avenue, Haddonfield; Harlan E. Goodell, 1123 Walnut street, Philadelphia, Pa., and Walter R. Sparks, 1807 Wynnewood Road, Philadelphia.

The Harlan & Hollingsworth Corporation, Wilmington, [illegible] will build a new pipe and rigger shop addition to its [illegible] plant, about 80 by 112 feet. Two other structures [illegible]ed, each one story, 20 by 80 feet, and 30 by 50

[illegible]Company, Chester, Pa., has awarded [illegible] a one-story addition to its works.

[illegible] Company, Twenty-eighth street, Bayonne, [illegible]rer of dredging machinery, is said to be planning [illegible]ly construction of its proposed new shipbuilding plant [illegible]perty recently acquired on the Raritan River near Perth Amboy.

The Fernandina Shipbuilding & Dry Dock Company, Dover, Del., has been incorporated, with a capital of $1,000,000, to build and operate a plant for the construction of vessels of different types. F. D. Buck, M. L. Horty and K. E. Longfield, Wilmington, Del., are the incorporators.

The Maryland Shipbuilding Company, Lexington building, Baltimore, Md., is arranging preliminary plans for the erection of a new shipbuilding plant near Bear Creek. The proposed plant is estimated to cost about $750,000. C. E. F. Clark is president of the company.

The Pusey & Jones Company, Wilmington, Del., has commenced the erection of additions to its plant to cost about $200,000. The company has expended a total of about $1,000,000 in plant extensions during the past year.

The New York Dry Dock Ship Construction Company, New York City, has recently been incorporated in Delaware, with a capital of $12,500,000, to build and operate a large plant for ship construction. Arthur W. Britton, Harry B. Davis and Samuel B. Howard, all of New York, are the incorporators.

The York River Shipbuilding Company, Port Richmond, Va., is considering the erection of a new shipbuilding plant on the Mattaponi River. Plans for the works are now being prepared. This company was recently incorporated, with a capital of $1,000,000. Warner Moore is president.

The Staten Island Shipbuilding Company, Mariners Harbor, Staten Island, N. Y., has filed plans for the erection of a new extension to its plant at Port Richmond to cost about $40,000. A new foundry building will also be erected at a cost of about $25,000.

The Submarine Boat Company, Bayonne, N. J., recently organized as a subsidiary of the Elco Company, Avenue A, Bayonne, manufacturer of motor boats and marine engines, has leased property consisting of about 110 acres at Avenue R, on the Newark meadows, Newark, N. J., as a site for a new plant for the construction of undersea craft and submarine chasers. The company is also planning to use a portion of the Elco plant at Bayonne for the manufacture of similar vessels, and is said to be considering extensions to the works. Henry R. Sutphen is vice-president.

The Newburgh Shipbuilding Company, Newburgh, N. Y., has been acquired by the Newburgh Shipyards, Inc., recently incorporated, with a capital of $3,000,000. The new company plans for the construction of additions to the present plant which is now in course of erection at an estimated cost of $200,000. Thomas C. Desmond, Bush Terminal building, Brooklyn, and John F. Farrell, South Norwalk, Conn., are heads of the company.

The Chester Shipbuilding Company, Chester, Pa., has been acquired by new interests, which plan to increase the capacity of the plant by the construction of four new shipbuilding slips, allowing the construction of twelve vessels at one time. The new organization is said to have acquired property at Bristol, Pa., fronting on the Delaware River, and plans for the construction of a new plant to be operated in conjunction with the Chester work. C. W. Hamilton is president; C. P. M. Jack, Swarthmore, is general manager.

The Newport News Shipbuilding & Dry Dock Company, Newport News, Va., has awarded a contract to James Stewart & Company, New York, for the erection of the proposed four-story addition to its plant. The structure will be about 50 by 250 feet.

The Transatlantic Shipbuilding & Lumber Construction Company, capitalized at $2,500,000, has been organized at Portland, Me., for the construction and operation of ships constructed of wood, steel and other materials. T. L. Croteau, of Portland, is president and A. B. Farnham, of Portland, is treasurer.

The Portland Ship Ceiling Company, Portland, Me., is building a new shipbuilding plant at East Deering.

The Meacham & Babcock Shipbuilding Company, recently incorporated in Seattle, Wash., is constructing four shipbuilding ways at Ballard, Wash., and eventually expects to have twelve ways available.

The Beaumont Shipbuilding & Dry Dock Company, Beaumont, Tex., has purchased a 60-acre island park property from the city of Beaumont, where it is now constructing a wooden shipbuilding plant, provision being made for eight building ways.

Christoffer Hannevig, Inc., 120 Broadway, New York, is head of the Newfoundland Shipbuilding Company, which is understood to have decided upon Harbor Grace for a site. According to report, several million dollars will be spent in equipping the plant, which will first turn out wooden vessels and later steel ships.

The Gulf Shipbuilding Company has been organized at Millville, Fla., with the intention of building wooden ships.

The Bagdad Shipbuilding Company has been organized at Bagdad, Fla., and plans to establish a yard to build wooden vessels.

The Trenton Shipbuilding Company, 15 Exchange Place, Jersey City, N. J., has been incorporated, with a capital stock of $500,000.

The Sunlight Building & Oil Company, Philadelphia, Pa., is reported to have acquired about 200 acres of land, with the intention of building a shipyard.

The Traylor Engineering & Manufacturing Company, Allentown, Pa., has acquired a tract of land on the Delaware River and is planning to build a shipyard.

Work has been started on the plant of the Tacoma Ship Company, Tacoma, Wash.

The G. M. Standifer Construction Company has been incorporated, with headquarters in Portland, Ore., and will erect a wooden shipbuilding yard.

The Florence Shipbuilding Company has been organized, with a yard in Florence, Ore. J. Fred Larsen, Portland, Ore., is the principal owner.

Sommarstrom Bros., of Oakland, Cal., are reported to be preparing plans for a shipyard at Columbia City, Ore.

Louis Paquet and Charles S. Miller, Kelso, Wash., are reported to have let contracts for a wooden shipbuilding plant.

Janes Bros. and Boomer, Crane & Howe, of Morgan City, La., have leased land for a wooden shipyard to be built on Berwick Bay.

The National Shipbuilding & Dry Dock Company has been incorporated by E. D. Flynn, John A. Calhoun and others, and will establish a shipyard at Savannah, Ga.

The Star Shipyards, New Orleans, La., have been incorporated by Walter Cook Keenan, H. M. Feild and Crawford Ellis, all of Louisiana. It is understood that the new company will establish a shipyard at Lake Ponchartrain, and that contracts have already been received to build six wooden ships.

The L. M. Dantzler Lumber Company, Moss Point, Miss., has announced that it will build a yard for the purpose of constructing wooden ships.

The American Shipbuilding Company has been organized in Brunswick, Ga., by the American Tie & Timber Company. The new company is reported to have received contracts to build several ships.

The Gulfport Shipbuilding Company, Gulfport, Miss. has been incorporated by Rapp Reynolds, R. Quinn, W. J. Faust and E. T. Childs.

Horton & Horton, Houston, Tex., will build a shipyard.

The Midland Contracting Company, Houston, Tex., has acquired a site of land and is planning to build wooden vessels.

The Carter Lumber & Building Company, Houston, Tex., has acquired a site and is planning to build wooden ships.

J. J. Stattegast, Jr., president of the Houston Car Wheel Works, Houston, Tex., is planning to build wooden ships.

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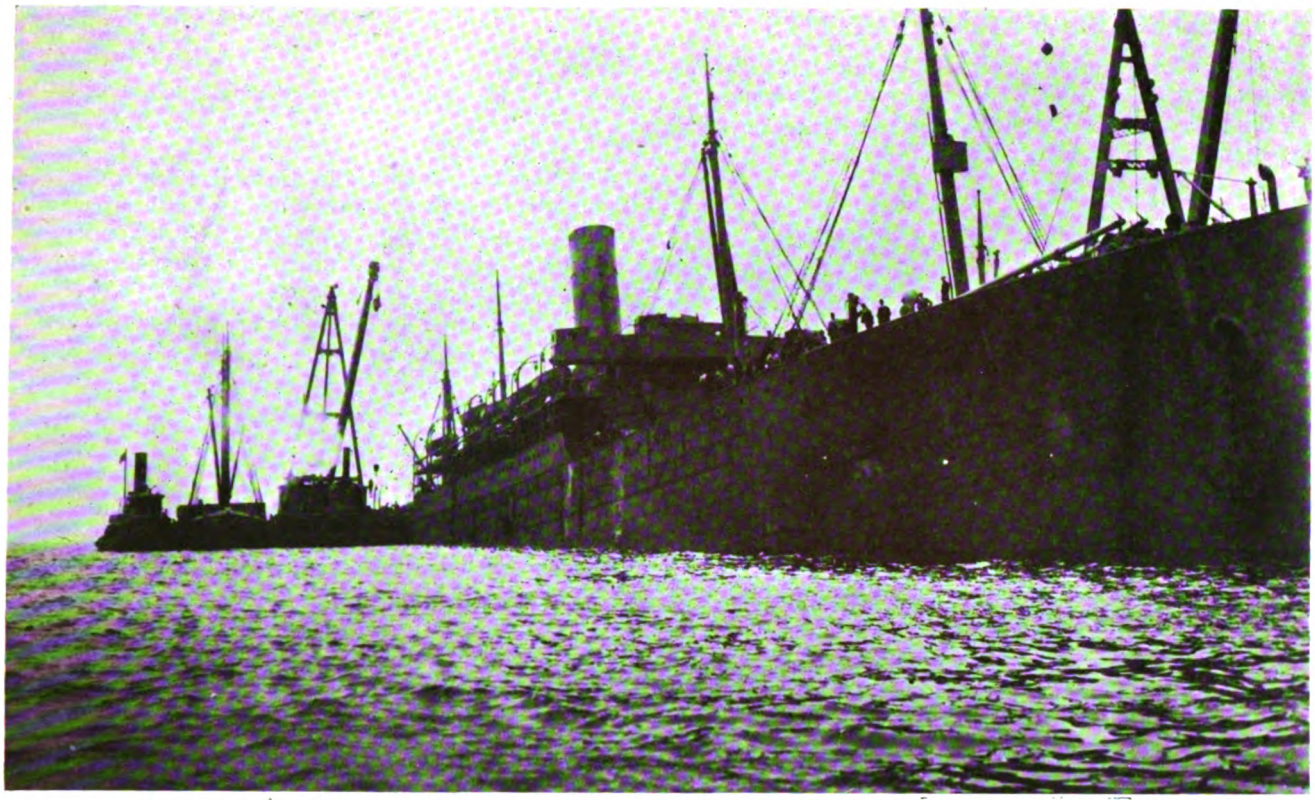

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S. S. *Manchuria* Damaged by Collision with U. S. Monitor *Amphitrite* in Dense Fog in New York Bay on Night of June 13. Holes in Starboard Side Flooded After Compartments

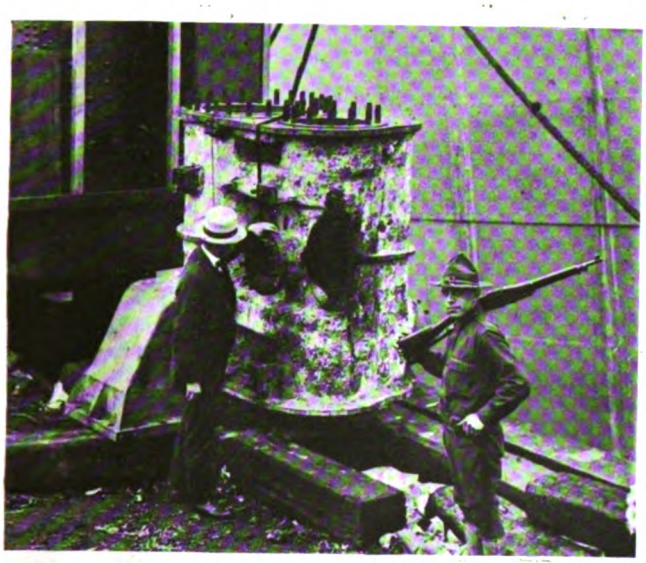
The City Council of San Diego, Cal., has granted permission to George W. Bush and Henry M. Coit, of San Diego, to build a shipyard on San Diego Bay.

The plant of the Tracy Brick & Art Stone Company, near San Diego, Cal., has been purchased by the Tracy Engineering & Shipbuilding Company, with the intention of converting it into a yard for the building of ships.

The Alaska Dry Dock & Manufacturing Company has leased a site of land at Juneau, Alaska, and has begun work on the construction of dry docks, marine ways, etc.

Several large companies are negotiating for water front property in the Borough of Queens, New York City, with the intention of establishing shipyards.

The McDougalz-Duluth Company, Duluth, Minn., announces that it will build a large shipyard at Ironton, Minn., on a tract of 85 acres.



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Engine Cylinder from German Ship *Ockenfels* Damaged by Crew Before Vessel Was Taken Over by U. S. Government

A charter has been issued in Dover, Del., incorporating the Great Eastern Shipyard & Dry Dock Company of New York. The announced capitalization is $30,000,000. It is impossible to find out who is back of this project.

F. R. Ward and S. Birkheimer, of Seattle, Wash., have organized the Ward & Birkheimer Shipbuilding Company, with headquarters at Olympia, Wash.

The Manitowoc Shipbuilding Company, Manitowoc, Wis., is making extensive improvements to its plant.

PERSONAL

H. W. HAND, formerly vice-president and general manager of the William Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa., has been elected president of the company, filling the vacancy caused by the resignation of Henry S. Grove. Mr. Grove has been made chairman of the board of directors, H. B. Taylor has been elected vice-president, and J. K. Mull general manager and director.

H. B. PICKERING, formerly connected with the William Cramp & Sons Ship & Engine Building Company, Philadelphia, Pa., and the New York Navy Yard, Brooklyn, N. Y., is now connected with the Foundation Company, New York, as naval architect and marine superintendent of the company's varied ship interests.

D. H. THOMSON has been elected president and treasurer of the Terry Steam Turbine Company, Hartford, Conn., filling the vacancy caused by the death of the late president, Mr. James Terry. N. L. Snow, formerly sales manager of the Terry Steam Turbine Company, has been elected vice-president.

JOHN H. BERNHARD, president of the Inland Navigation Company, New York, has returned to the United States after a six months' stay in Holland.

CHARLES E. HYDE, whose death in New York was recently announced, was the designer of the first triple-expansion marine engine ever placed in a ship in this country.

FRANK A. SMALL, of Bath, Me., member of the firm of Percy & Small, builders of some of the largest schooners engaged in the Atlantic coastwise trade, died recently at Somerville, Mass., aged fifty-three. Mr. Small was formerly mayor of Bath.

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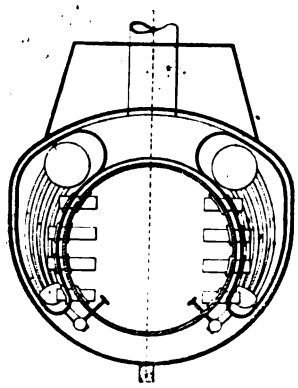
SELECTED MARINE PATENTS

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents, compiled by Delbert H. Decker, Esq., registered patent attorney, Millerton, N. Y.

1,209,678. WATER-TUBE BOILER FOR SUBMARINES. GREGORY C. DAVISON, OF NEW LONDON, CONN., ASSIGNOR TO ELECTRIC BOAT COMPANY, A CORPORATION OF NEW JERSEY.

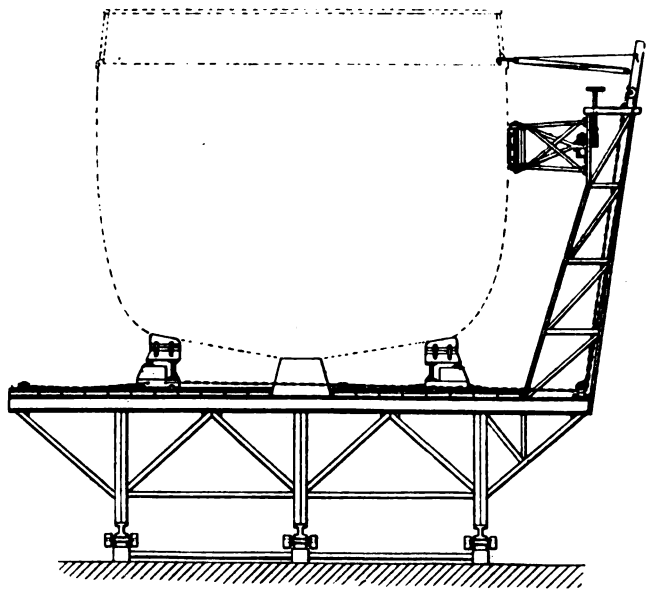
Claim 12.—In a submarine boat of the double-hull construction, in combination, a ballast tank located within the inter-hull space, a boiler compartment located within the ballast tank and spaced from the



bounding walls of the ballast tank, a water-tube boiler located in the boiler compartment, burners extending through the wall of the inner hull and the wall of the boiler compartment, and means for flooding said boiler compartment upon submergence of the vessel and operable from within the inner hull. Fourteen claims.

1,210,425. RAILWAY DRY DOCK. JAMES L. CRANDALL, OF MALDEN, MASS., ASSIGNOR TO CRANDALL ENGINEERING COMPANY, OF EAST BOSTON, MASS., A CORPORATION OF MAINE.

Claim 1.—In a railway dry dock, a cradle having an upright wing, and a thrust element arranged on said wing adapted for engagement



with the side of the vessel, comprising two toggle-members, and a thrust-roll and operating-means for said members. Five claims.

1,206,850. VENTILATION SYSTEM FOR STORAGE-BATTERY CELLS. ALBERT S. HUBBARD, OF NEW YORK, N. Y., ASSIGNOR TO GOULD STORAGE BATTERY COMPANY, A CORPORATION OF NEW YORK.

Claim 1.—In a cooling and ventilating system for electric battery cells, a closed compartment for containing the battery, sealed battery cell casings in said compartment, an inlet pipe leading from a point outside of said compartment into said compartment, and comprising branches having sealed connections with said sealed casings, to provide communication with that portion of the interior of said sealed casings above the level of the electrolyte therein, an outlet pipe comprising branches having sealed connections with that portion of said sealed casings above the level of the electrolyte therein, to provide communication with the interior of the said sealed casings, and extending to a point outside of said compartment, and an exhaust pump attached to said outlet pipe.

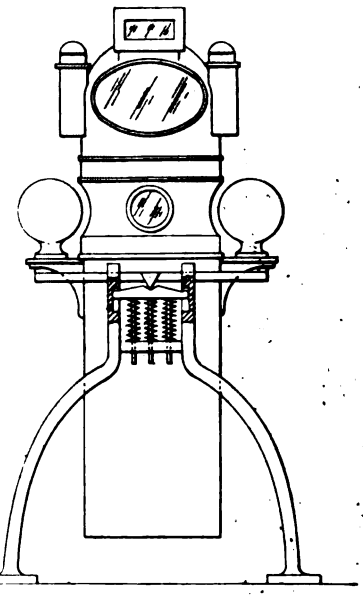
1,191,211. STEERING AND REVERSING TILLER. CHRISTOPHER J. MEYER, OF MILWAUKEE, WIS., ASSIGNOR TO EVINRUDE MOTOR COMPANY, OF MILWAUKEE, WIS., A CORPORATION OF WISCONSIN.

Claim 1.—A tiller provided with a releasing latch, and an operating handle, adapted, by rotation upon its own axis, to actuate the latch from one latching position to another on the opposite side of the axis about which the tiller swings. Eleven claims.

British patents compiled by G. F. Redfern & Co., chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 10 Gray's Inn place, W. C., London.

102,644/16. RELATING TO SHIPS' BINNACLES. L. P. NELSON, S/S DOONHOLM, OF 2 SELBOURNE STREET, SOUTH SHIELDS.

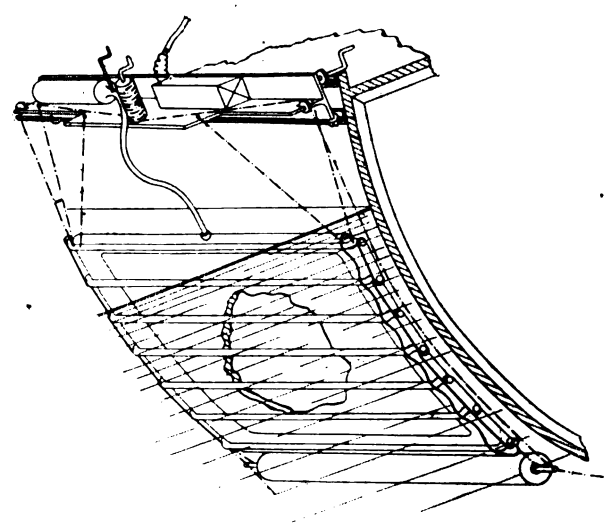
The binnacle rests by its knife edges or equivalents on the gimbal ring, which ring is provided with knife edges or equivalents, one on opposite sides of ring, which rests on a slide bar capable of vertical movement in slots in the upper part of the legs, which are bolted or otherwise secured to the deck. The slide bar is supported or rests on



springs bearing by their lower ends on a bar fixedly secured to the legs, said slide bar being provided with guide rods which pass through said springs and fixed bar. With an arrangement as above set forth and shown not only will the binnacle always remain plumb, but sudden shocks will be absorbed by the spring-cushioning device.

101,479/16. APPARATUS FOR CLOSING LEAKS IN SHIPS OR THE LIKE. DR. F. WULLYAMOZ AND G. MEYER, BOTH OF LAUSANNE, SWITZERLAND.

This invention relates to apparatus for closing leaks which comprise the combination of a mat made of flexible material, a roller carried by the mat, a frame adapted to make a tight joint with the hull of the ship, a truck traveling on longitudinal rails of the ship and



carrying the apparatus for manipulating the mat including ropes passing under the hull of the ship and so that the mat can unfold against a damaged portion of the hull and be kept there by the pressure of the surrounding water. In mats of this kind it has been proposed to provide electro-magnets or flexible india-rubber tubing on the frame adapted to make the joint watertight, but according to this invention a chamber inflated or filled with compressed fluid is used.

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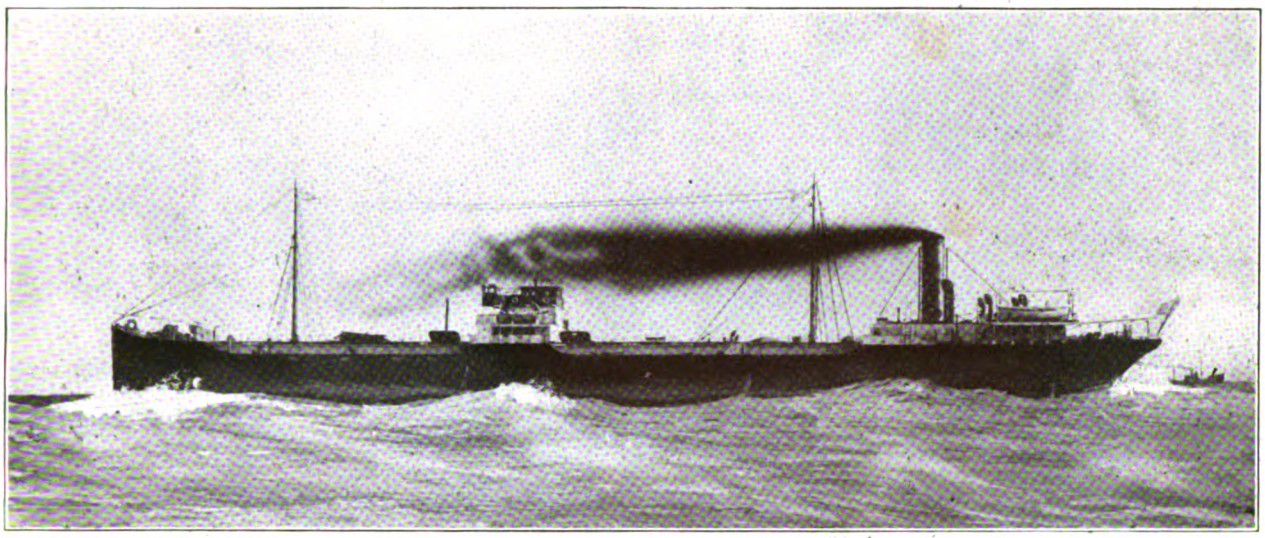

Photo. courtesy Westinghouse Machine Co.

Smaller Bunkers—More Cargo Space

Freights are higher than they have ever been known. They may even go higher yet.

Every *extra* ton of coal carried in the bunkers and burned in the furnaces means one ton less deadweight capacity —money lost instead of money earned —doubly and trebly earned at present rates.

Waste heat eats up a lot of coal. It calls for extra bunker-room and extra firing to meet losses which are largely avoidable by proper protection of boilers and steam-lines.

The best protection against these heat-losses is "85% Magnesia" coverings.

"85% Magnesia" coverings protect Uncle Sam's battleships and destroyers, as well as many of the largest liners and cargo-carriers. They use "85% Magnesia" because experience has proved its value, not only in saving coal, but in increased engine-room efficiency, in ability to withstand constant vibration and shock, in the ease with which it can be removed and replaced for repairs to boilers or steam-lines, and more than all these, to secure *dry* steam.

Specify "85% Magnesia" coverings for all new construction and for all renewals or alterations of old steam installations.

"85% MAGNESIA"

The Universal Covering for Pipes and Boilers

MAGNESIA ASSOCIATION OF AMERICA, 702 BULLETIN BLDG., PHILADELPHIA, PA.

(The Member Companies of this Association are contractors to the U. S. Army and Navy and to munition plants.)

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TRADE PUBLICATIONS

The Dow Diesel Engine is described and illustrated in a catalogue published by the Dow Pump & Diesel Engine Company, Alameda, Cal. "To build Diesel engines requires a good design and a well-equipped machine shop. The Dow Diesel is of proven design and the Dow shops are equipped for the highest class machine work."

The Main Street Iron Works, San Francisco, Cal., have issued a circular describing their marine engines, anchor windlasses, cargo hoists, capstans, steering engines, oil and feed water heaters and other auxiliary machinery; marine, tubular and watertube boilers, tanks and plate work. "Special facilities for ship repair work."

[illegible] ht **Arizona"** is the [illegible] can Blower Com- [illegible] fans are rejuired [illegible] spheric condition. [illegible] to co-operate in [illegible]

[illegible] **alves,** with encased springs, are described in a bulletm published by Crane Company, 836 South Michigan avenue, Chicago, Ill. "Encased spring valves are necessary on marine boilers where a number of valves are connected to one main exhaust or discharge type. These valves comply with all the requirements of the United States Board of Supervising Inspectors of Steam Vessels, and may be set at any pressure specified up to 250 pounds.

Woodworking machinery for yard and factory is described in Catalogue 118, published by the American Saw Mill Machinery Company, 50 Church street, New York. "Speed up your work, use American machinery. Sawmills, eight sizes, for all diameters and lengths of logs and for resawing dimension timbers; woodworking machinery for yard and factory; cut-off saws; rip saws; swing saws; band saws; planers; variety woodworkers; jointers; hoists.

Oil firing is one of the subjects treated upon in the marine catalogue published by Schutte & Koerting Company, 1253 North Twelfth street, Philadelphia, Pa. "Undoubted advantages are obtained with the mechanical oil-firing system. With the Koerting Mechanical System the oil, which is first perfectly heated, is brought under pressure and leaves the centrifugal burner perfectly atomized. The Marine catalogue gives full details."

Hanna Riveters are described and illustrated by the Hanna Engineering Works, 2075 Elston avenue, Chicago, Ill. "The results obtained from a Hanna riveter in the construction of modern ships will soon pay for even the most expensive types of handling equipment. We manufacture riveters in more than 115 sizes, any of which can be arranged for use as portable or stationary punches by the addition of a dash-pot mechanism."

Perfect circulation is assured by the use of the Equilibrium Circulator, according to a circular published by H. Bloomsburg & Company, 425 North Carey street, Baltimore, Md. "Not only stops foaming and pitting of boilers, but prevents deposit of mud and sediment and the formation of scale by obtaining and maintaining a perfect circulation of the water. The only successful, practical device of its kind made. Easily and quickly installed. Saves its cost many times over."

"The Best Proof" is the title of a circular published by the Allen Manufacturing Company, 135 Sheldon street, Hartford, Conn. One of the illustrations in this circular shows a test block broken by a ¾-inch Allen set screw. "This photograph is the best proof we can give you that the Allen screw is strong. It shows a test block broken by a ¾-inch Allen safety set screw. The screw was allowed to project above block to make the test more severe. All sizes from ¼ inch to 1½ inches furnished. Any length, point or thread. Send for circular and free sample screws for testing."

[illegible] " is the advice given [illegible] l Electric Company, [illegible] rised how much real [illegible] hipboard. Passengers [illegible] light, and the electric [illegible] advertisement for your [illegible] electric equipment on board ship will give the same continuous satisfactory service as the G-E generator in the big power plants ashore—they are built with the same knowledge, experience and reputation behind them."

Hack Saws for the power house are one of the 2,100 machinists' tools described in Catalogue 21-L, published by the L. S. Starrett Company, Athol, Mass. "You want Starrett saws because they last longer and cut faster."

Metal berths for ships are described in a catalogue issued by the Southern-Rome Company, 617A West Pratt street, Baltimore, Md. "These berths are lightweight, all-steel and malleable iron. They occupy little space and are absolutely sanitary. They make a good appearance and give maximum comfort to the sleeper. Southern-Rome Metal Berths are used in the United States Navy, on Unietd States light vessels, dredges, etc., and also on a great number of merchant vessels."

Whitlock Manila Rope is the subject of a circular published by Department M of the Whitlock Cordage Company, 46 South street, New York. "You cannot get less than good service out of Whitlock manila rope—nothing but good hemp, along with careful workm[illegible]in, goes into its making. We guarantee this rope to be [illegible]s. of uniformly high grade, with no 'mixtures' and [illegible] or excess lubrication. Whitlock manila posse[illegible]'est degree, safety, strength and wearing [illegible]ny rope so extensively used for ma[illegible]anila gives service."

Universal Motor Drills a[illegible] published by the United States Elec[illegible] nati, Ohio. One of the illustrations [illegible] Westinghouse motor drill. "The drill s[illegible] felt want, as you can take this drill to a[illegible] voltage is 110 or 220 volts, and attach the plu[illegible] socket whether direct or alternating current. Dri[illegible] is of ⅞-inch capacity in steel. The motor is air-cooled, run in grease. New type switch. Superior in power to [illegible] drill on the market of the same weight. Dimensions, 6 by [illegible] inches; weight, 28 pounds. Other size Universal drills, ⅜ inch and ½ inch, sent on trial."

"The Electric Rudder Indicator" is the title of Bulletin No. 40, which has just been published by the Electro-Dynamic Company, Bayonne, N. J. "The application of electrical energy for various uses on board ship has made rapid strides during the last ten years, and not only are all modern ships lighted by electricity, but most of the auxiliary machinery is now driven by electric motors, and much of the signaling is also accomplished by the use of this agent. There was a time when ship owners, and the operating force of same, had considerable mistrust against electrical apparatus, fearing unreliability, but time has proven that such fears were ill-founded, and the use of electricity on board ship is gaining from year to year. Some years ago this company put upon the market an electrical rudder indication which wherever installed has given perfect satisfaction. Owing to some other development in the electrical line which absorbed the full capacity of our factory, the electrical rudder indicator was crowded to one side for a time, but continued inquiries and repeat orders have convinced us that it is too good a device for this state of affairs."

"Sturtevant Power Apparatus" is the title of Bulletin 213 just issued by the B. F. Sturtevant Company, Hyde Park, Boston, Mass. "Sturtevant power apparatus, fully developed, well designed and efficient, covering a wide range of application, is already well known both in this country and abroad. For more than half a century the name Sturtevant has been synonymous with excellence and efficiency in the matter of apparatus for handling air and gases. Later developments in the line of engines, turbines and economizers followed the standard established in the case of fans and blowers. Irrefutable proof of the acknowledged quality of Sturtevant power apparatus is furnished by the list of users. The great lighting and power companies of New York, B[illegible] Chicago, Cleveland and many other cities, the main[illegible]nts of the Steel Corporation, paper mills, tex[illegible] miscellaneous manufacturing establishments [illegible]ve for years used Sturtevant fuel economize[illegible] draft apparatus. Repeat orders, coming [illegible]om these discriminating buyers, signify satis[illegible]ish evidence of the excellence of Sturtevan[illegible] sea, also, our apparatus has found wide app[illegible]ted by numerous installations of electric [illegible]d forced draft equipment on ships of the U[illegible] Our engineers, who are specialists in their [illegible] service at all times for consultation and advice. [illegible] pose of this book to give a general description [illegible] plete line of Sturtevant power apparatus. Spec[illegible] describing each particular product are published, a[illegible] such publications will be found on page 27. These [illegible] sent on request and a return postcard has been inser[illegible] the convenience of those desiring this detailed informati[illegible]

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